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Podium and Poster Abstracts

NOTE: Disclosure information is listed at the end of this document.

***Denotes presenter**

MAOA FIRST PLENARY SESSION
April 20, 2017

Effectiveness of Intraoperative Exparel, A Bupivacaine Liposome Injectable Suspension for, Postoperative Pain Control in Total Knee Arthroplasty: A Prospective, Randomized, Double Blind, Controlled Study

Abstract ID: Paper 001

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INTRODUCTION: Pain control following total knee arthroplasty (TKA) heavily influences timing of mobilization and length of hospital stay postoperatively. We studied the effectiveness of periarticular liposomal bupivacaine in TKA postoperative pain control, including impact on early mobilization and length of hospital stay, compared to another local analgesic, Ropivacaine, when both are used as part of a multimodal pain management approach.

METHODS: We performed a double-blind, randomized, controlled, prospective, IRB-approved study on opioid naïve patients with a primary diagnosis of osteoarthritis undergoing a unilateral TKA with a single surgeon at a single institution between May 2014 and March 2015 (n=96). Patients with prior knee replacement, inflammatory arthritis, unilateral knee replacement, bilateral TKA, or opioid tolerance were excluded. Study participants were randomized into a control group, given the standard intra-articular injection (ropivacaine, ketorolac, morphine, and epinephrine in saline; 100 cc), and experimental group, given a similar intra-articular injection (bupivacaine, ketorolac, morphine, and epinephrine in saline; 80 cc) plus 1.3% liposomal bupivacaine (20 cc; total injection 100 cc). Postoperative pain management and physical therapy were standardized. The frequency and total use of oral and intravenous narcotic use was recorded during hospital stay. We also recorded Visual Analog Pain scores, hours to ambulate 100 feet, and length of hospital stay (hours).

RESULTS: Control group, N=49, and study group (liposomal bupivacaine), N=47. There was no significant difference between the groups in mean narcotic use per hour (differed by 0.1 mg), total narcotic (hydrocodone) use during hospital stay (experimental: 97.7 mg ± 42.84; control:

89.6 mg ± 58.57), mean length of stay (experimental: 59.0 ± 13.7 hours; control: 60.3±23.7 hours), time to ambulate 100 feet (experimental: 27.3 ± 17.4 hours; control: 26.4 ± 19.4 hours), or Visual Analog Score for pain on day 1 or day 2 postoperatively.

CONCLUSION: When comparing liposomal bupivacaine to ropivacaine as part of a multimodal pain management approach in TKA, there is no difference in postoperative opioid consumption, Visual Analog Scores for pain, amount of time to ambulate, or length of hospital stay.

Non-Operative Management of Medial Meniscus Posterior Horn Root Tears Have a Poor Prognosis at Five-Year Follow-Up

Abstract ID: Paper 002

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BACKGROUND: Medial meniscus posterior root tear tears (MMPRTs) are a significant source of pain and dysfunction, but little is known about the natural history and outcome and for non-operative management of these lesions.

HYPOTHESIS/PURPOSE: To evaluate (1) the clinical and radiographic outcomes of non-operative treatment of MMPRTs, and (2) risk factors for worse outcomes.

STUDY DESIGN: Level IV retrospective study

METHODS: A retrospective review was performed for patients with unrepaired MMPRTs and a minimum 2-year follow-up. Knee arthroplasty rates were recorded and the remaining patients were contacted to obtain final IKDC subjective outcome and Tegner activity scores. Baseline and final radiographs were reviewed and categorized according to Kellgren-Lawrence scores. Baseline MRIs were reviewed for the presence of meniscal extrusion, subchondral edema, and insufficiency fractures. Failure was defined as conversion to arthroplasty or severely abnormal IKDC score. Kaplan-Meier survival analysis was used to evaluate the effect of risk factors for poor outcome and conversion to arthroplasty.

RESULTS: 52 patients (21M: 31F) with a mean age of 58±10 years were diagnosed with MMPRTs and followed for a mean of 62±30 months. Sixteen patients (31%) underwent total knee arthroplasty at a mean of 30±32 months after diagnosis. Mean IKDC scores for the remaining patients at final follow-up was 61.2±21. There was a non-significant decrease in mean Tegner scores from baseline to final follow-up (3.7±1.2 vs. 3.3±1.2). Mean Kellgren-Lawrence grades on weight-bearing anteroposterior radiographs progressed over time (1.5±0.7 vs. 2.4±1.0; $p<0.001$), and significantly more patients had grade 2 or higher arthritis at final follow-up compared to baseline (78% vs. 51%; $p=0.01$). Overall, 87% of patients failed non-operative treatment, including 94% of females and 72% of males. Males had a superior final IKDC score 75±12 compared to 49±20 for females ($p=0.03$). Higher baseline Kellgren-Lawrence grade (2 or more compared to less than 2) was the only factor associated with increased rate of arthroplasty ($p=0.01$). No MRI findings were associated with worse IKDC or Tegner scores.

CONCLUSION: Non-operative treatment of medial meniscus posterior horn root tears is associated with an alarming clinical failure rate, worsening arthritis, and a relatively high rate of arthroplasty at 5-year follow-up. Female gender was associated with worse clinical outcomes.

Surgical Pen Contamination in ACL Reconstruction

Abstract ID: Paper 003

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OBJECTIVES: The purpose of this study was to assess whether the skin marking pen is a vector for contamination during arthroscopic anterior cruciate ligament reconstructions (ACLR). We hypothesized that surgical marking pens used to delineate the proposed skin incision will be culture positive.

METHODS: Ten surgical marking pens were collected prospectively from patients undergoing ACLR. All patients received standard preoperative prepping and draping with Duraprep. Proposed incisions were marked with a new sterile pen, and the pen tip was immediately sent for 5-day inoculation in broth and Agar. Negative controls (unopened new pen) and positive controls (marking of the skin incisions prior to prepping) were also cultured. Additionally, blank culture dishes were followed during the growth process. All pens were removed from the surgical field prior to incision and new marking pens were used when needed during the procedure.

RESULTS: Two of the ten study pens (20%) demonstrated positive growth. Both pens grew species of Staphylococcus. None of the negative controls demonstrated growth, 5 of the 7 positive controls showed growth, and none of the blank dishes exhibited growth. Organisms found were predominantly Staphylococcus, but also included Bacillus and Aspergillus.

CONCLUSION: We found a 20% rate of surgical marking pen contamination by Staphylococcus during ACLR. Infections are rare but may result in significant morbidity, and all measures to reduce these should be sought after. Surgeons performing ACLR should consider disposal of the surgical marking pen following skin marking and prior to intraoperative use such as graft markup. Estimated cost of a new sterile pen is approximately $1.

MAOA BREAKOUT SESSION #1
HAND/ELBOW
April 20, 2017

Orthopedic Upper Extremity Conditions in Developing Countries: A Review of Clinical Research

Abstract ID: Paper 005

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HYPOTHESIS: Although surgical treatment of upper extremity conditions continues to be a major challenge in low- and middle- income countries (LMICs), no study to date has assessed the upper extremity research conducted in LMICs. The purpose of this scoping review is to identify published research from LMICs related to upper extremity conditions, quality of research, identify knowledge gaps, and prioritize future research. We hypothesize that existing research in LMICs are predominantly low level evidence studies.

RESULTS: A total of 115 studies were identified from 2004-2014. 8% were performed collaboratively between a LMIC and a HIC. 73% were conducted by orthopedic surgeons, 6% by general surgeons, 3% by plastic surgeons, and 4% by orthopedic and plastic surgeons working collaboratively. Most studies were conducted in South Asia (61%) or sub-Saharan Africa (18%). Pakistan (30%), Nepal (18%), and India (10%) were the most represented countries. Most of the papers focused on traumatic (76%) followed by degenerative (8%) disease etiologies. The three most common conditions included in studies were distal humerus fractures (22%), hand fractures (8%), and humeral shaft fracture (8%), and distal radius fracture (7%). Eleven studies (10%) were classified as level II evidence or higher and 79% of the studies were either a retrospective or prospective case series. Only 16 studies (14%) used a control group and only 5 studies (5%) utilized randomization. Collaboration with non LMIC was not found to be associated with more rigorous research methodology (P=0.362).

CONCLUSION: Upper extremity research in LMICs is primarily focused on traumatic injuries with distal humerus fractures, hand fractures, and humeral shaft fracture being most commonly studied. There are very few studies published from LMIC countries and most is of low quality. This study highlights the need for interventions that foster research and support more rigorous research methodology for research in LMIC pertaining to upper extremity conditions.

Narcotic Wasting in Hand and Upper Extremity Surgeries

Abstract ID: Paper 006

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INTRODUCTION: Narcotic abuse and dependence has become an epidemic in the United States. Many people who abuse narcotics had their first exposure to these drugs with prescription medication. Narcotics are commonly prescribed after outpatient hand and upper extremity surgery, but oftentimes the patients' need for opioids may be significantly less than what is prescribed. The purpose of this study is to evaluate how many prescribed narcotic pills are going unused after outpatient hand and upper extremity surgery. Secondarily, we will evaluate patient and surgical variables for correlation with high opioid use and narcotic wastage.

METHODS: All patients undergoing surgery at a single outpatient hand and upper extremity center over an 8-week period were recruited to the study. On the first postoperative visit, all patients were given a questionnaire which asked about number of pills used, need to obtain more medications, and pain control. Additionally, demographic data and details about surgery were obtained through chart review.

RESULTS: Completed questionnaires were collected on 151 patients on an average of 12.2 days postoperatively. The average age was 47 years, the most common procedure performed was carpal tunnel release, and the mean length of procedure was 64 minutes. Patients were prescribed an average of 37 narcotic pills and an average of 15.5 pills were not used. A total of 2,305 pills went unused, accounting for 44.6% of all prescribed narcotics. 107 patients reported having unused pills. Of these patients, 16 planned on discarding or destroying and only two brought their unused pills back to the pharmacy. Twenty-five patients obtained additional narcotics outside of the original prescription through a trip to an emergency department, calling into the office, or visiting another physician. Of these patients, 10 (40%) had a history of baseline narcotic use. The average pain control rated by patients was 8.3 on a 10 point scale, 0 being not controlled at all and 10 being completely controlled.

CONCLUSION: A large number of narcotic pills are going unused after outpatient hand and upper extremity surgery, and the majority of these unused narcotics are not being returned to the pharmacy or to the provider. With the growing opioid epidemic, it is important for physicians to be cognizant of their potential contribution to this problem. By evaluating our patients' use of narcotics after common procedures, we can change our prescribing patterns to successfully reduce the number of unused narcotics.

Patient Characteristics Affect the Anatomic Dimensions and Location of the Median Nerve

Abstract ID: Paper 007

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SUMMARY: The dimensions and location of the median nerve (MN) in the carpal tunnel vary with patient factors. Shorter patients and females are more likely to have a decreased distance from the hamate to the MN (H-M), as well as a decreased width of the MN, with potential for increased MN injury during carpal tunnel release surgery (CTR).

INTRODUCTION: Damage to the MN or its branches represent a serious complication of CTR. However, minimal data exist regarding average MN anatomy. The goal of this study was to define a standard H-M distance and MN width, and evaluate their variability across different patient demographics.

PATIENTS AND METHODS: MRI studies of the wrist were retrospectively reviewed for 150 adult patients. On axial images, H-M distance was from the hamate to the MN. MN width was measured from medial to lateral at its widest point. Age, gender, ethnicity, height, weight, and body mass index (BMI) were recorded for all patients. Statistical analysis was performed using Pearson's correlation coefficient (r), Student's t-test, and ANOVA with a significance level of 0.05.

RESULTS: Mean patient age was 42.9 years (18.0-82.0). 94 patients were female and 56 were male. Mean reported height, weight, and BMI were 1.67 m (1.49-1.95), 82.5 kg (48.0-195.0), and 29.5 (16.2-54.0), respectively. 43% of patients were African-American, 29% Caucasian, 13% Hispanic, 12% other, and 2% Asian.

Mean distance from the hamate to the ulnar border of the median nerve and median nerve width were 9.57 mm (4.90-14.5) and 5.19 mm (2.10-7.80), respectively. HM distance demonstrated moderate correlation with patient height ($r=0.399$), weak correlation with weight ($r=0.207$), and weak correlation with age ($r=0.077$). Median nerve width demonstrated weak correlation with patient height ($r=0.176$), weak correlation with weight ($r=0.089$), and weak correlation with age ($r=0.099$).

Statistically significant ($p<0.05$) decreases in HM distance and MN width were found for females and shorter patients. Age and race were not significant for any changes in the measured indices.

DISCUSSION/CONCLUSIONS: This study suggests that the location and size of the median nerve can vary with patient demographics. Shorter patients and females are likely to have a decreased H-M distance and MN width, potentially placing them at higher risk of MN injury following CTR. This information may be useful in recognizing higher risk patients, and help surgeons plan where to make their incisions in CTR.

Measurement of Wrist Motion: A Comparison of Visual, Manual, and Three Dimensional (3-D) Goniometry

Abstract ID: Paper 008

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IINTRODUCTION: Wrist motion is a critical, objective outcome measure for surgeons and therapists. Surrogates of skeletal alignment have been shown to have varying accuracy, precision, and reliability. The purpose of this study is to evaluate the time, accuracy, and reliability of three methods of wrist goniometry (visual, manual, and 3-D motion) in both the novice and non- novice observer.

METHODS: Fifty-one volunteers were selected including 19 Novices and 32 Health Care professionals. Radiographs were obtained as the gold-standard of maximum wrist skeletal motion. A prono-supination standard was obtained by the average of several measurements using the Distal-Forearm Method. Participants assessed maximum wrist motion of one normal wrist, by visual estimation, manual measurements, then utilizing custom 3-D motion analysis software. Each method was performed twice and timed. To assess the accuracy of each respective method, a composite score was made using the mean absolute differences between the measured and actual motion in all planes.

RESULTS: There was no significant difference between composite accuracy of any method, each falling within 4° of the standard; however, 3-D (2.7°) and manual (1.9°) trended towards more accurate than visual (4.0°). Novice evaluators were noted to be within 5.28° of the mark when assessed visually. By the second test, novices improved visual and manual composite scores by 1° and 3°, respectively, nearing the accuracy of non-novice participants. Manual was significantly slower than both visual and 3-D methods. Novices were significantly slower than non-novices with both visual and manual, but not using the 3-D method. Residents and hand fellows were overall faster and more accurate than hand surgeons, but not significantly so. 3-D demonstrated significantly lower variability than both visual and manual. Visual measurements were significantly more variable than manual goniometry.

DISCUSSION AND CONCLUSION: Given that visual goniometry is fast and with reasonable accuracy, this method may be considered in the everyday clinical practice. Even in the novice observers, accuracy within 5° can be expected when assessed visually. Manual goniometry was the slowest method but trended towards the most accurate. 3-D goniometry, because of its accuracy, speed, and low variability, may find a role in both the clinical and research settings. Lastly, novice observers are able to improve visual and manual assessment after practice, nearing the accuracy of hand surgeons.

Total Wrist Arthroplasty in Patients Younger than 60 Years of Age: An Analysis of 261 Consecutive Primary Arthroplasties

Abstract ID: Paper 009

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PURPOSE: The outcomes of upper extremity small joint arthroplasty in young patients has yet to be examined. The purpose of this investigation was to define the association between a young age and outcomes after TWA.

METHODS: Using our institution's total joint registry, 445 consecutive primary TWA arthroplasties were performed at our institution from 1974 to 2013. The average age was 57 years (16-83). There were 261 arthroplasties performed in patients <60 years of age. In these younger patients, the surgical diagnoses included osteoarthritis (3%), inflammatory arthritis (91%), and post-traumatic arthritis (PTA, 7%). The implants in this study included Remotions (n=19), Biax (n=99), Volz (n=10), Meuli (n=91), Universal (n=4), and Swanson (n=38). Cement was used in 215 (82%), while 27 (10%) required augmentation with bone graft.

RESULTS: Overall, there were 110 (25%) TWA arthroplasties that required revision surgery at a mean of 5.4 years postoperatively. In the young patients (<60 years), 81 (31%) required revision surgery at a mean 5.6 years postoperatively for loosening (n=36), component fracture (n=6), infection (n=7), wrist instability (n=20), and other (n=12). Risk of revision surgery was not associated with age taken as a continuous variable (p=0.44), but there was an increased risk of revision surgery when comparing those younger than 60 to those older than 60 years (HR 1.61, p=0.02). The 5, 10, and 20-year implant survival rates for the patients <60 years were 80%, 70%, and 60%, respectively, which was significantly lower than older patients. Amongst the younger patients, the risk for revision surgery was increased in osteoarthritis, but this was not significant. Swanson implants had improved implant survival. In the younger patients, there were 4 intraoperative complications involving fracture in the younger patients. Postoperative complications in the younger patients included dislocation (n=24), infection (n=13), postoperative fractures (n=11), implant loosening (n=41), recurrent subluxation (n=17) heterotopic ossification (n=5), tendon/ligament injury (n=12), and wear (n=6). The risk of carpal component loosening was increased in patients younger than 60 years, while dislocation and fractures were not.

SUMMARY POINTS: Younger age lead to slightly higher rate of revision surgery and complications, particularly implant loosening after total wrist arthroplasty. Swanson implants performed better in this younger population. These findings help when counseling patients, estimating risk, and potentially evaluating risk in health policy.

Is Free Vascularized Bone Grafting Superior for Scaphoid Nonunion?

Abstract ID: Paper 010

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INTRODUCTION: Symptomatic scaphoid nonunion occurs in 10 to 15% of fractures. Nonvascularized bone grafting (NVBG), and pedicled and free vascularized bone grafts (VBG) have been employed with variable success. Regarding VBG, while the traditional 1,2-intercompartment supraretinacular artery (1,2-ICSRA) distal radius bone graft is limited by its pedicle, the free medical femoral condyle (MFC) graft permits greater deformity correction. We thus sought to compare our institution's experience using NVBG via structural iliac crest bone graft (ICBG), 1,2-ICSRA, and MFC grafts to treat scaphoid nonunions.

METHODS: We performed a retrospective review between 2000 and 2013 of all scaphoid nonunions treated at our institution. After excluding patients with less than 6 months of follow-up were excluded, there were 35 that underwent ICBG, 43 that underwent 1,2-ICSRA, and 41 that underwent MFC bone grafting. Mean time to follow-up was 16 months (range 6 to 164). Patients that underwent reoperation prior to 6 months were included. Mean age at surgery was 24 years (range 11 to 66). Males comprised 87% and the dominant extremity was involved in 60% of cases. Tobacco use was noted in 21% of subjects. Outcomes included time to healing, range of motion, complications, and reoperations.

RESULTS: Union rates and mean time to union were 69% and 20 weeks for ICBG, 71% and 45 weeks for 1,2-ICSRA, and 95% and 16 weeks for MFC, respectively. The use of an MFC graft, absence of tobacco use, younger age, and male gender were correlated with healing ($p = 0.004$, 0.002, 0.005, and 0.01, respectively). Time from injury to surgery did not affect healing ($p = 0.30$). There was no significant difference between the 3 groups in regards to change in wrist flexion, wrist extension, radial deviation, ulnar deviation, and grip strength. There were 28 overall reoperations, including 26% in the ICBG group, 15% in the 1,2-ICSRA group, and 32% in the MFC group.

CONCLUSIONS: The use of a free vascularized MFC graft has demonstrated promising results in the literature. This comparative study demonstrates superior union rates with a more rapid time to union compared to NVBG and pedicled dorsal distal radius VBG. Clinical outcomes are similar, and when excluding reoperation for hardware removal, the reoperation rates are not dissimilar. In cases of symptomatic scaphoid nonunion with osteonecrosis and carpal collapse, the MFC is a viable and reliable surgical option, even as salvage for prior failed structure grafting procedures.

Infection Rates of Buried vs. Exposed Kirschner Wires in Phalangeal, Metacarpal, and Distal Radius Fractures

Abstract ID: Paper 011

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PURPOSE: Our goal is to determine if there is a difference in infection rates between exposed and buried K-wires when used to treat phalanx, metacarpal, and distal radius fractures.

METHODS: We conducted a retrospective review identifying all patients over 16 years of age at our institution who underwent fixation of phalanx, metacarpal or distal radius fractures with K-wires between 2007 and 2015. We recorded patient demographic data as well as location of fracture, number of K-wires used, whether K-wires were buried or left exposed, and duration of K-wire placement. Infectious complications were separated into five groups based on treatment: (1) oral antibiotics, (2) oral antibiotics + early pin removal, (3) IV antibiotics without early pin removal, (4) IV antibiotics with early pin removal, and (5) IV antibiotics + surgical debridement. Data was analyzed using equal variance t-test, chi-square test, Fisher's exact test, or unequal variance t-test, as appropriate.

RESULTS: 695 patients met the inclusion criteria. Surgeons buried K-wires in 207 (29.78%) patients, and left K-wires exposed in the remaining 488 (70.22%) patients. Infections occurred in 80 exposed K wire cases (16.4%) and 19 buried K wire cases (9.2%) resulting in a statistically significant relative risk of infection for patients with exposed K-wires of 1.79 (95% CI: 1.11-2.87; p=0.01). Subgroup analysis based on fracture location revealed a statistically significant increased risk of infection for exposed pins when used in metacarpal fractures (RR= 2.25; 95% CI: 1.13-4.49; p=0.02).

CONCLUSION: Patients with exposed K-wires for fixation of phalanx, metacarpal, or distal radius fractures were more likely to be treated for a pin site infection than those with K-wires buried beneath the skin. Metacarpal fractures treated with exposed K-wires were 2.25 times as likely to get a postoperative infection. To decrease infection rates when pinning hand and wrist fractures, particularly metacarpal fractures, surgeons should consider burying K-wires beneath the skin subcutaneously.

Level of Evidence: Level III, Retrospective Review

Value Analysis of Operative Management of Distal Radius Fractures at a Major Metropolitan Health System

Abstract ID: Paper 012

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INTRODUCTION: The incidence of distal radius fractures (DRFs) is approximately 640,000 cases per year and accounts for 25% of fractures in the elderly. Fragility fractures, like DRFs, account for a large proportion of the annual $8.2 billion expenditure in orthopedic surgery. As healthcare costs rise and surgeon volumes increase with the aging population, more emphasis is being levied on providing value-based, cost-effective care. The purpose of this study is to provide a cost analysis of the operative management of DRFs in in a large metropolitan healthcare system.

METHODS: A retrospective cost-identification study design was used to evaluate cost data from two large hospital locations within a metropolitan hospital system. A variety of cost and profit metrics were collected (i.e., surgical supply/material cost, charge to patient, direct costs, indirect costs, net revenue, net income, and contribution margin) and were tested against multiple cost predictors including hospital center, surgeon volume, surgeon subspecialty training, CPT coding, and length of stay. Statistical analyses included logistic regression, chi-square cross tab analysis, and multinomial regression. All statistical tests were performed in “R” statistical software.

RESULTS: There were 342 operative DRFs between 2010 and 2014, with 253 (74%) performed at Hospital 1 and 89 (26%) at Hospital 2. The overall net income for distal radius fractures was negative (-$580.40), while overall contribution margin was positive (+$1,444.10). The majority of direct cost was accounted for by implants (56%) and surgical supplies/dressings (35%). The top quartile of cases with the highest contribution margin had significantly less spending on implants ($p<0.01$). Hand-fellowship trained surgeons had significantly higher contribution margins compared to their trauma counterparts ($1478 vs. $576, $p=0.03$). The institution at which the operation was performed significantly influenced net income (Hospital 1 = -$929.20 vs. Hospital 2= $411.00, $p=0.001$). Length of stay had no correlation with contribution margin, but as expected, was strongly correlated with indirect cost ($r= 0.70$).

DISCUSSION: The observed income gap between hospitals, coupled with the large difference between contribution margin and net income, show the impact indirect costs have on the profitability of operative treatment of DRFs. In order to maximize profit when treating this increasingly common upper extremity fracture, our data suggests that lower implant costs and treatment by hand-fellowship trained surgeons can optimize contribution margins. In addition, methods to minimize surgical supplies/dressing costs, facility variability, and shorten length of stay are other viable strategies to reduce cost.

Does Metacarpophalangeal Arthroplasty Performed on Border Digits Lead to Worse Outcomes?

Abstract ID: Paper 013

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HYPOTHESIS: It is traditionally thought metacarpophalangeal (MCP) arthroplasties perform worse on border digits. The purpose of this investigation was to assess the correlation between border digits and outcomes after MCP arthroplasty.

METHODS: 340 consecutive primary MCP arthroplasties were performed on border digits, either the 2nd (n=209) or 5th (n=131). This was compared to 349 arthroplasties performed in either the 3rd (n=207) or 4th (n=142) non-border digits. Demographics of border (vs. non-border) arthroplasties include 82% female (vs. 80%), average age of 61 years (vs. 60), BMI of 26 (vs. 26), with diagnoses of inflammatory arthritis (85% vs. 85%), osteoarthritis (10% vs. 9%), and post-traumatic arthritis (5% vs. 6%). Implants utilized included pyrocarbon (33% vs. 33%), silicone (56% vs. 56%), and SRA (11% vs. 11%).

RESULTS: There were 26 MCP arthroplasties in the border digits (18 in 2nd, 8 in 5th) that required revision surgery. Etiologies include stiffness (n=2), dislocation (n=20; 13 in the 2nd), implant fracture (n=1), and recurrent deformity (n=2). Risk of revision surgery was not associated with border digit (HR 1.17, p=0.59). The 2-, 5-, and 10-year implant survival rates for border digits were 96%, 93%, and 87%, respectively, which was not different from non-border digits. When examining each finger, the index finger had a slightly increased risk of implant failure (HR 1.38, p=0.28). Amongst border digits, younger patients and those requiring bone grafting had increased risks of implant failure. Silicone implants had improved implant survival compared to pyrocarbon or SRA. Diagnosis did not influence risk of revision surgery. Complications in the border digits included dislocation (n=26), infection (n=5), intraoperative fracture (n=6), and postoperative fracture (n=1). The risk of dislocation was not different in border vs. non-border digits. In border digits, the risk of dislocation was greater in pyrocarbon implants and lower in silicone implants ($p<0.001$). In unrevised patients at a mean 5.2 years follow-up (1-15), preoperative to postoperative pain levels significantly improved border digit arthroplasties ($p<0.001$). MCP total arc of motion significantly improved from 38° preoperatively to 43° postoperatively ($p<0.001$), with similar improvements in pinch strength. There were no differences between border and non-border digits regarding pain, MCP motion, or pinch strength.

SUMMARY POINTS: MCP arthroplasty in border digits had similar outcomes to non-border digits. Silicone implants have improved outcomes in border digits, while pyrocarbon have worse outcomes. MCP arthroplasty performed in border digits results in predictable pain relief, preservation of range of motion, with low complications.

Ultra Small Proximal Pole Scaphoid Nonunion Reconstruction with 1,2 Intercompartmental Supraretinacular Artery Vascularized Graft and Micro Screw Fixation

Abstract ID: Paper 014

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INTRODUCTION: Scaphoid fractures can be successfully treated with cast immobilization in most cases; however, there is an estimated 5-15% nonunion rate with these fractures. More proximal fractures have a higher risk of avascular necrosis (AVN) given the more limited blood supply of this region. The results of the 1,2 ICSRA vascularized graft for scaphoid nonunions has had varying success in the literature, ranging from 27% to 100%. When we look closer at the published articles, there is substantial inconsistency in the fractures that are being treated, modalities for assessing healing, and fixation methods used. We hypothesized that small proximal pole scaphoid fractures could be managed successfully with fixation achieved by using a 1,2 ICSRA vascularized graft and a smaller diameter (≤ 2.5 mm diameter) compression screw.

METHODS: This is a retrospective case series of 12 patients with ultra-small proximal pole scaphoid fracture nonunions that were treated at our institution with 1,2 ICSRA vascularized grafts and compression screws. Calculations of the size of the proximal pole fragment relative to the total scaphoid were performed using Posterior-Anterior Scaphoid view radiographs with the wrist in ulnar deviation and flat on the cassette. Analyses were repeated three times per subject, and the average ratio of proximal pole fragment relative to the entire scaphoid was calculated. We reviewed medical records, radiographs, and CT scans of these 12 patients. CT scans that were performed after an average of 12 weeks were ultimately used to confirm union of the scaphoid fractures.

RESULTS: 12/12 (100%) scaphoid fractures healed at an average of 11.45 weeks as shown by CT scan. The mean proximal pole fragment size was 18% (range 7-27%) of the entire scaphoid.

CONCLUSION: The 1,2 ICSRA vascularized graft and compression screw is an effective operation for patients with very small proximal pole scaphoid fractures. Previous studies have unsuccessfully used this surgery for waist fractures and have included a mix of patients treated with Kirschner wires and screws. The benefit of this study is that we included only patients with proximal pole fractures and included only patients treated with a compression screw and were able to show the success of the proposed operation.

When All Else Fails: Outcomes of Arthrodesis for Management of Failed Basal Thumb Arthroplasty

Abstract ID: Paper 015

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INTRODUCTION: Basilar thumb arthritis is often treated with carpometacarpal arthroplasty. When arthroplasty fails, often due to pain or subsidence, salvage operations may be indicated. Fusion of the basilar thumb joint is an option but may have increased complications. Current literature does not adequately outline the indications for and results of thumb arthrodesis in the setting of failed basilar thumb arthroplasty.

METHODS: IRB-approved retrospective review was performed of all patients undergoing fusion following failed basilar thumb arthroplasty between 1990-2016. At latest follow-up, data including grip strength, radiographic appearance, complications and need for revision surgery were recorded.

RESULTS: The series includes 7 thumbs in 6 patients (3 female, 3 male) with average age at surgery of 53 (range 45-61). Average follow- up was 27.5 months (range 9-66). Patients had on average 2 prior surgeries (range 1-7) and an average of 42 months duration from initial basilar thumb surgery (range 24-60). Prior basilar thumb surgeries consisted of trapeziectomy and suspensionplasty (6), pyrocarbon implant arthroplasty (2), and failed fusion attempt after suspensionplasty (1). All cases elected to undergo thumb fusion surgery due to persistent pain, with one patient also complaining of subsidence and deformity.

Surgical intervention included fusion between thumb and index metacarpals and trapezoid (6) and fusion between thumb metacarpal and trapezoid in the setting of failed implant arthroplasty (1). Fixation was achieved using Kirschner wires alone (5) or Kirschner wires and screw fixation (2). Autologous bone graft was used in all cases with the addition of allograft in 2 patients.

Average imaging follow-up (radiograph or computerized tomography scan) was 22 months (range 4-61) which showed fusion in 5/7 thumbs. Patients had average grip strength of 64% (expressed as percent of contralateral), appositional grip 72%, and oppositional grip 79% at average follow-up of 27 months.

Complications included minor pin site infection treated with oral antibiotics (2) and symptomatic screw hardware requiring removal (2). Five patients experienced delayed union, 4 were asymptomatic and observed. One symptomatic patient underwent successful revision fusion with cannulated screw fixation.

CONCLUSIONS: Fusion after failed thumb arthroplasty is a reliable pain relieving procedure; however, complication rates are high (58%). Risk of delayed or nonunion is high with 5/7 patients (71%) experiencing delayed (4) or nonunion (1). This study is significant as it enables surgeons to provide reasonable expectations regarding outcomes of fusion for failed arthroplasty of the first carpometacarpal joint.

The Effect of Preoperative MCP Hyperextension on Functional Outcomes After Basilar Thumb Arthroplasty

Abstract ID: Paper 016

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PURPOSE: In the surgical treatment of thumb carpometacarpal (CMC) joint arthritis, the effect of mild preoperative metacarpophalangeal (MCP) hyperextension on postoperative functional outcomes is unknown. We sought to examine outcomes after surgical treatment of CMC arthritis in patients with and without mild pre-existing MCP deformity.

METHODS: A retrospective review was conducted analyzing the functional outcomes of patients treated for CMC arthritis from March of 1998 to May of 2009. Assessments included pinch and grip strength, degree of MCP hyperextension, and thumb radial and palmar abduction. Statistical analyses used included t-test assuming unequal variances.

RESULTS: A total of 203 patients were followed for an average of 27.2 months. Patients were divided into two groups: (1) patients without preoperative MCP hyperextension (167 patients); (2) patients with mild but untreated preoperative MCP hyperextension (<= 30°) (36 patients). All patients underwent either a Weilby procedure (118 patients) or a ligament reconstruction tendon interposition (LRTI) (85 patients). Analysis of the preoperative data showed no difference in the baseline parameters among both groups, with the exception of MCP hyperextension. No patient in Group 1 had any preoperative hyperextension, and the average preoperative hyperextension deformity in Group 2 was 13.4°, with a range of 3° to 30°. Postoperatively, there were no significant differences in key pinch, tip pinch, grip strength, and radial or palmar abduction of the thumb. Both groups showed improved pinch strength and thumb radial and palmar abduction after surgery. Group 1 showed an improvement in grip between pre- and postoperative measurements, while Group 2 showed a slight decrease in grip strength; however, the differences between Group 1 and 2 were not statistically significant.

CONCLUSIONS: While patients in both groups showed uniform improvement in almost all functional parameters after surgery, there were no statistically significant differences in improvement when comparing patients without preoperative MCP hyperextension to patients with mild preoperative MCP hyperextension.

Level of Evidence: Level III – Retrospective Comparative Study

MAOA BREAKOUT SESSION #2
SPORTS
April 20, 2017

A Comprehensive Functional Capacity Evaluation for the Determination of Safe Return to Play Following ACL Reconstruction

Abstract ID: Paper 017

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Advances in anterior cruciate ligament reconstruction (ACLR) and rehabilitation have led to improved outcomes and expedited return to play (RTP). However, there is significant variability in the criteria used by physicians to give clearance for RTP following ACLR. In this study, we created a comprehensive test for RTP developed to include the assessment tools that have the most validity according to the literature. The purpose of this study was to evaluate the ability of our comprehensive Functional Capacity Evaluation (FCE) to predict safe RTP following ACLR. The FCE consists of three separate components: subjective, clinical, and functional. The subjective component is comprised of questionnaires to track self-reported outcomes (IKDC, KOS-ADL, and KOS-sport). The clinical component includes assessment for effusion, active ROM, passive ROM, and muscular strength. The functional component consists of a landing form assessment, hop testing, and three task-specific qualitative assessments. All components are administered sequentially once the patient's physician has determined they may be ready. Patients who fail the FCE were allowed to repeat testing after further rehabilitation. 72 FCEs were administered to 54 subjects who previously underwent ACLR performed by the senior author (SCC). Of those, 41 passed and 31 failed; many subjects who failed repeated FCE after additional rehabilitation. Of the 31 failed attempts, 20 failed the clinical component, and 11 failed the functional component. Of 24 patients who failed on the first attempt, 11 subsequently passed and 13 never passed. Of those who passed and were cleared for RTP, only 1 subject sustained injury to the repaired knee (2.4%). For those patients who decided to RTP after failing the FCE, 4 subjects sustained reinjury to the same knee (30.8%). Further data regarding long term patient satisfaction and outcomes is currently being gathered. The FCE demonstrated a significant ability to determine whether a patient was ready to RTP based on reinjury rates ($p=0.002$). We believe this comprehensive FCE can be utilized to standardize the process of advising patients wishing to RTP following ACLR.

What is Opioid Demand After ACL Reconstruction?

Abstract ID: Paper 018

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BACKGROUND: Postoperative opioid demand after anterior cruciate ligament reconstruction (ACLR) is not well understood. The purpose of this study was to define the natural history of opioid demand after ACLR with concomitant procedures and to evaluate preoperative opioid demand as a risk factor for postoperative opioid demand.

METHODS: Arthroscopic ACLRs performed in the Humana Inc. database between 2007-2014 were identified using CPT code 29888. Further categorization of procedures was performed by identifying patients who only underwent ACLR with no other procedures, those who underwent ACLR with meniscus repair, those who underwent ACLR with menisectomy, and those who underwent ACLR with microfracture. Postoperative opioid demand was trended by month following surgery for 1 year. Relative risk of postoperative opioid use was calculated and 95% confidence intervals (CI) were determined.

RESULTS: Over the course of the study period, 4,946 arthroscopic ACLR's were performed. Of these, 7.24% were still filling opioid prescriptions at 2-3 months after their procedure; 4.71% of patients were filling opioid prescriptions at 1 year after surgery. Patients undergoing ACLR with microfracture were at increased risk of filling narcotic prescriptions compared to the other procedure groups. At 4-5 months postoperatively, ACLR with microfracture had increased risk of filling narcotic prescriptions compared to ACL alone 1.96 (CI=1.32-2.92), ACL with meniscus repair 2.38 (CI=1.46-3.88), and ACL with meniscectomy 1.51 (CI=1.03-2.23). Nearly 35% of patients (1,716/4,946) were taking opioid pain medications in the 3 months prior to ACLR. Those filling preoperative opioid prescriptions were 5.34 (CI=4.12-6.94) times more likely to be filling narcotic prescriptions at 2-3 months after ACL reconstruction (15.38% vs. 2.88% for non-users).

DISCUSSION AND CONCLUSIONS: Opioid demand after ACLR drops significantly in the vast majority of patients by the third postoperative month. Surprisingly, 35% of patients undergoing ACLR were found to be filling opioid medications preoperatively and we identify preoperative opioid use to be a strong predictor of postoperative opioid demand with a 5 to 7 fold increased risk in this patient population. Surgeons and healthcare systems should be aware a large portion of patients undergoing ACLR are receiving preoperative opioid prescriptions which put these patients at significantly increased risk for extended postoperative opioid demand. In the setting of preoperative care for patients who will undergo ACLR, healthcare providers should pursue non-opioid prescribing regimens in an effort to limit postoperative opioid demand.

Long-Term Strength and Functional Outcomes in Patients Receiving Femoral Nerve Block vs. Local Infiltration in Anterior Cruciate Ligament Reconstruction

Abstract ID: Paper 019

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PURPOSE/HYPOTHESIS: To determine if previously reported strength and functional deficits in patients undergoing femoral nerve block (FNB) resolves at long term follow-up. Our hypothesis was that in patients undergoing ACL reconstruction, treatment with FNB vs. local infiltration would result in no significant difference in strength and functional outcomes at long term follow-up.

METHODS: Forty-three patients undergoing primary ACL reconstruction were assessed for eligibility. Study arms included either intraoperative local infiltration of liposomal bupivacaine (20mL-bupivacaine/10mL-saline) or preoperative FNB, with a primary outcome of long-term strength and functional outcomes. All patients underwent a comprehensive rehabilitation program that included isokinetic strength and functional testing at greater or equal to 9 months postoperatively comparing the operative and non-operative extremity. A multivariable analysis was performed to control for age, gender, BMI, graft type, and differences in time of test postoperatively.

RESULTS: No significant difference in deficit percentages were found an average of 10.6 months postoperatively (range 9-15 months) in the FNB group, with respect to slow isokinetic extension strength (22.4% vs. 27.8%, P = .51), fast isokinetic extension strength (18.5% vs. 12.5%, P = .41), slow isokinetic flexion strength (11.0% vs. 15.1%, P = .55), and fast isokinetic flexion strength (8.2% vs. 4.9%, P = .56). With respect to functional outcomes, there also was no difference in deficits for Single leg hop distance (P = .12), Timed single leg hop (P = .73), and single-leg triple hop distance (P = .94). Forty percent of patients regained full strength (within 10% of contralateral limb) and 63% of patients regained full function at an average of 10.6 months postoperatively.

CONCLUSION: Although previous studies have reported strength and functional deficits in patients undergoing FNB, these deficits are not permanent and are not different when compared to controls at long-term follow-up. Patients are likely to recover function before full strength and should be informed that recovery of strength and function may continue past 1 year postoperatively.

Preoperative Pain Perceptions Are Predictive of Physical Therapy Performance, Healthcare Resource Utilization, and Postoperative Symptoms After Anterior Cruciate Ligament Reconstruction: A Minimum One-Year Follow-Up Study

Abstract ID: Paper 020

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BACKGROUND: Anterior cruciate ligament reconstruction requires extensive postoperative rehabilitation with high reported rates of persistent symptoms. There is emerging evidence that certain psychological traits including anxiety or fear of pain, individual differences in pain coping strategies, and severe subjective pain prior to surgery can adversely affect outcomes after elective orthopedic surgery. The goal of this study is to investigate the predictive effect of preoperative pain perceptions phyiscal therapy performance, healthcare resource utilization, and persistent symptoms after anterior cruciate ligament (ACL) reconstruction.

METHODS: A total of 72 patients (mean 29.5 years SD 13.4; 37 male, 35 female) who underwent ACL reconstruction completed a battery of preoperative self- administered survey instruments related to subjective pain (McGill pain questionnaire), subjective knee symptoms (IKDC subjective score), anxiety related to pain (pain catastrophizing scale or PCS), fear of reinjury or pain from movement (Tampa scale for kinesiophobia or TSK and Fear Avoidance Beliefs Questionnaire or FABQ), pain coping methods (brief COPE, and Pain Coping Methods or PCM). The association between these preoperative scores and number of postoperative pain scripts, office visits, office telephone encounters, re-injury and return to sport within 12 months as well as physical therapist documented poor perceived effort were analyzed.

RESULTS: Increased preoperative McGill pain scores were predictive of a higher requested number of postoperative pain scripts (R-square 0.10, p=0.007), pain-related telephone encounters in the first month (p=0.002), and decreased return to sport (p=0.04). High pain catastrophizing scores (PCS) and kinesiophobia scores were associated with poor perceived effort in rehabilitation (p=0.002 and p=0.04), decreased rates of return to sport (p=0.001 and p=0.03), and increased re-injury rates (p=0.04 and p=0.02). Low preoperative IKDC scores were predictive of a higher number of postoperative pain scripts (p=0.02), and number of telephone encounters in the first year (p=0.005). Lower pain coping scores on the PCM emotional coping subscale were predictive of higher total number of pain scripts filled (p= 0.03) and number of telephone encounters in the first year (p= 0.03).

CONCLUSIONS: Preoperative pain perceptions are significantly associated with effort in physical therapy and functional outcomes such as return to sport after ACL reconstruction. Additionally, maladaptive pain perceptions appear to be predictive of higher healthcare resource utilization postoperatively as well as higher re-injury rates.

Radial Tears of the Lateral Meniscus - Two Novel Repair Techniques: A Biomechanical Study

Abstract ID: Paper 021

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The purpose of this study was to biomechanically evaluate two novel techniques used to repair radial tears of the lateral meniscus. The two novel techniques were compared biomechanically to the cross suture method described by Matsubara et. al. using an inside out technique. The novel repair techniques will result in a lower displacement after cyclic loading, an increased load required to displace the repair 3 mm, a higher load to failure, decreased displacement at load to failure, and increased stiffness of the repair. The result will be a construct that more closely recreates the function of the intact meniscus.

METHODS: 36 fresh frozen cadaver tibial plateaus containing intact menisci were obtained. The menisci were divided into three groups (n=12 in each group). Each meniscus was repaired simulating an inside out technique. Radial tears were created at the mid-body of the lateral meniscus and repaired using the three techniques. The repaired menisci were attached to the Instron and tested both cyclically and loaded to fail.

RESULTS: Displacement after cyclic loading: cross suture displaced 4.78 mm ± 1.65 mm, hashtag 2.42 mm ± 1.13 mm, and crosstag 3.13 mm ± 1.77 mm. The hashtag and crosstag repairs both resulted in significantly less displacement (p=0.003 and 0.024) compared to the cross suture repair.

LOAD TO FAILURE: The cross suture technique was 81.43N ± 14.31, hashtag 86.08N ± 23.58N, and the crosstag 62.50N ± 12.15N. The cross suture and the hashtag repairs both resulted in a higher load to failure vs. the crosstag (p=0.009 and 0.009).

CONCLUSIONS: The two novel repair techniques, hashtag and crosstag, did not demonstrate superiority in terms of load to failure or stiffness, but both the hashtag and the crosstag repairs were statistically superior to the cross suture repair when measuring displacement after cyclic loading.

Partial Meniscectomy Provides No Benefit for Degenerative Medial Meniscus Posterior Root Tears

Abstract ID: Paper 022

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BACKGROUND: Medial meniscus posterior root tears (MMPRTs) are a significant source of pain and dysfunction, but little is known about the outcome for meniscectomy as the management of these lesions.

OBJECTIVES: To determine (1) the efficacy of partial meniscectomy to treat MMPRTs compared to a matched group of non-operatively treated MMPRTs, and (2) risk factors for worse outcome and subsequent arthroplasty for the study group as compared to the control group.

STUDY DESIGN: Level III Matched Cohort Study

METHODS: This retrospective comparative study was performed to include 27 patients with MMPRTs that were treated with arthroscopic partial medial meniscectomy (PMM) and a minimum 2-year follow-up. These patients were then to a group of 27 patients treated without partial meniscectomy. Demographic data, radiographic findings, final Tegner and IKDC scores were obtained and compared between the two groups.

RESULTS: In the PMM group, final median Tegner score was three, mean IKDC scores were 67.8±20, mean KL grades on weight-bearing AP films demonstrated progressive arthritis (1.32±0.8 vs. 2.4±1.0 $p<0.001$) and more patients had grade II or higher arthritis at final follow-up than baseline (86% vs. 36%; $p<0.01$). When comparing the PMM and control groups, there was no significant difference in final median Tegner scores, IKDC, K-L grades, progression to arthroplasty, time to arthroplasty or overall failure rate. For risk factors in the PMM group, female patients had lower final IKDC scores (74.6±16.7 vs. 44.00±2.8, $p=0.02$) and median Tegner scores (4 vs. 3, $p=0.009$) compared to males, as well as a higher rate of arthroplasty than males (70.6% vs. 20.0%, $p=0.009$). Higher BMI correlated with lower IKDC scores ($r=-0.91$, $p=0.01$) and meniscal extrusion was associated with higher rate of arthritis at final follow-up (100% vs. 57%, $p=0.02$).

CONCLUSION: Partial meniscectomy for the treatment of MMRTs is associated with a very high progression to arthroplasty, significant arthritis, and poor clinical outcomes at over 5-year follow-up. Compared to a non-operative control group, there was no benefit in any subjective or objective outcome measures from the arthroscopic partial meniscectomy. Overall, females and patients with higher BMI had worse outcomes and higher associated rates of subsequent total knee arthroplasty.

Medial Meniscal Root Injuries in the Pediatric and Adolescent Population

Abstract ID: Paper 023

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INTRODUCTION: Meniscal root injury in the pediatric population has been infrequently described in literature, yet diagnosis and treatment of pediatric meniscal pathology is an increasingly important topic for many care providers in a time of high levels of youth athletic participation. The purpose of this study is to describe prevalence, tear patterns, associated injuries, and treatment implemented for uncommon medial meniscal root injuries in the youth population.

METHODS: Consecutive patients < 18 years old surgically treated for meniscal pathology over a 36-month period were reviewed. Demographics, sport participation, mechanism, and associated injuries were documented. Coronal MRI sequences were evaluated for the presence of medial meniscal extrusion. Arthroscopic image review was utilized to categorize root tears according to the Laprade classification system.

RESULTS: Twelve patients (3.8%) with medial meniscal root injuries were identified within a series of 313 patients. The mean age was 15.8 years (13.4-17.8). Ten of 12 patients were skeletally mature upon presentation. Sport participation included football (5), soccer (3), motocross/BMX (2), basketball (1), and dodgeball (1). Nine of 12 (75%) patients sustained a contact or high-energy mechanism; while three (25%) were non-contact injuries. Nine patients (75%) had an associated ligament injury (5 ACL tears, 1 tibial spine fracture, and 3 multi-ligamentous injuries) and 6 (50%) had an associated lateral meniscal injury. Meniscal extrusion was present on 9 (82%) of the 11 MRI studies available. A medial root bony avulsion, classification type 5, was the predominate injury and noted in 8 (67%) of 12 patients. All 5 patients under 16 years of age exhibited this Type 5 injury pattern. All eight patients with a type 5 injury had a history of contact or high-energy mechanism. In comparison to patients in this population with medial meniscal tears, those with medial root injuries were more likely to have a history of a contact or high energy mechanism ($p<001$); and exhibit meniscal extrusion ($p<.001$). Eleven patients (92%) underwent an arthroscopic anatomic repair with an interosseous tunnel, and one (8%) lesion was not amenable to a repair.

CONCLUSIONS: Medial meniscal root injuries are uncommon yet may occur in the pediatric and adolescent population. They may present following contact or higher energy mechanisms and in conjunction with a ligamentous injury. The presence of medial meniscal extrusion on MRI should alert the provider to the possibility of a root injury.

Degenerative Progression of Medial Meniscal Root Tears on Serial MRIs

Abstract ID: Paper 024

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BACKGROUND: Medial meniscus posterior root tear tears (MMPRTs) are a significant source of pain and dysfunction, but little is known about the interval progression of the medial compartment of the knee on MRI with the presence of this injury.

HYPOTHESIS/PURPOSE: To evaluate (1) the degenerative progression of MMPRTs on MRI, and (2) risk factors for worsening structural changes.

STUDY DESIGN: Level IV retrospective study

METHODS: A retrospective review of the institutional database was performed for patients with an initial diagnosis on baseline MRI of a complete medial meniscal posterior root tear with available follow-up MRIs. MMPRTs were classified using the LaPrade Classification system for meniscal root tears and medial femoral and tibial articular cartilage were graded using the Outerbridge classification system. Baseline and follow-up MRIs were also reviewed for the presence and amount of meniscal extrusion, subchondral edema, and insufficiency fractures with or without subchondral collapse. In order to account for differences in time between interval MRI, patients were then divided into two groups: Group 1 had a follow-up MRI within 12 months of the initial MRI and Group 2 had a follow-up MRI greater than 12 months after the initial MRI.

RESULTS: There were 41 knees and 82 MRIs included in our study overall. Twenty knees and 40 MRIs were assessed in group 1 with a mean interval of 4.8±2.6 months between initial and final MRI. Twenty-one knees and 42 MRIs were assessed in group 2 with a mean interval of 38.2±20.8 months between initial and final MRI. In both groups 1 and 2, meniscal extrusion, medial femoral articular cartilage Outerbridge grade, and medial tibial articular cartilage Outerbridge grade worsened at a significant rate between initial and final MRI (Group 1: $p=0.03$, $p=0.05$, $p=0.004$; Group 2: $p=0.02$, $p=0.0002$, $p=0.001$, respectively). In group 2, the presence of subchondral cysts in the femur was significantly higher at final MRI vs. initial MRI ($p=0.03$). In both groups, there were no significant differences between initial and final MRI in regards to the LaPrade classification, presence of insufficiency fracture with or without subchondral collapse, or presence subchondral cysts within the tibia.

CONCLUSION: Articular cartilage degenerates at a progressively high rate on both the medial tibia and medial femur in patients with MMPRTs over time. Subchondral edema may improve within 12 months of initial diagnosis, but appears to worsen with longer follow-up.

Influence of Knee Alignment on Tibial Tuberosity to Trochlear Groove and Posterior Cruciate Ligament Distances

Abstract ID: Paper 025

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INTRODUCTION: For patients with patellar instability, tibial tuberosity to trochlear groove (TT-TG) and tibial tuberosity to posterior cruciate ligament (TT-PCL) distances are both used to assess the need for tibial tuberosity medialization. The current study utilized computational modeling to characterize the influence of knee orientation within a scanner on both measurements.

METHODS: Computational models were developed from MRI data to represent knees of eight patients with recurrent patellar instability. Points were identified on the femur to represent the deepest point of the trochlear groove and the most posterior points on the medial and lateral femoral condyles. Points were identified on the tibia to represent the center of the tibial tuberosity, the medial edge of the PCL fossa, and the most posterior medial and lateral points at the proximal tibia. The tibia was rotated to 5° internal/external rotation, and the entire knee was rotated to 5° adduction/abduction in 1° increments. At each position, a computational algorithm quantified the TT-TG distance along the femoral medial-lateral axis and the TT-PCL distance along the tibial medial-lateral axis. Regression analyses were performed to relate knee rotation to tuberosity distance measurements.

RESULTS: TT-TG distance increased with tibial external rotation, and both TT-TG distance and TT-PCL distance increased with leg abduction ($r^2 > 0.99$ for all regressions). The average slope relating TT-TG distance to tibial external rotation was 0.50 mm/° (range: 0.31 to 0.60 mm/°). The average slope relating TT-TG distance to leg abduction was 1.01 mm/° (range: 0.85 to 1.29 mm/°), compared to 0.48 mm/° for TT-PCL distance (range: 0.32 to 0.68 mm/°).

DISCUSSION: TT-TG distance is more dependent on orientation of the knee in the scanner than TT-PCL distance due to both points being on the tibia and a smaller proximal-distal distance between the points for the latter measurement. Tibial external rotation varies with the orientation of the toes and knee flexion angle. Leg abduction varies with the orientation at the hip. Understanding these variations in the measurements with knee orientation is important when utilizing a cut-off value to determine suitability for tibial tuberosity medialization.

CONCLUSION: The influence of knee orientation in the scanner on the TT-TG and TT-PCL distances should be considered when using these values to guide treatment selection. Variations in knee orientation have less influence on TT-PCL distance than TT-TG distance.

The Reliability and Validity of Patellar Instability Ratios

Abstract ID: Paper 026

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INTRODUCTION: A reliable and valid method for identifying patients at risk for recurrent lateral patellar instability has yet to be described. The traditional tibial tubercle to trochlear groove (TT-TG) distance represents an absolute value that does not account for anatomic diversity. A recent report suggests that anatomic specific measurements may be more predictive of recurrent instability. This evidence includes a series of ratios in which the TT-TG distance was normalized to various patellar and trochlear measures on magnetic resonance imaging. Specifically, ratios with trochlear width (TW) and patellar width (PW) as denominators were notably more predictive of recurrent instability. We sought to determine the reliability and validity of these ratios.

METHODS: Eighty-seven patients experiencing a first-time lateral patellar dislocation between 1990 and 2010 were included in the study. Magnetic resonance imaging of each knee following the index injury was reviewed by two orthopedic surgery residents. The TT-TG, PW, and TW measurements were obtained in a blinded and randomized fashion. Intraclass correlation coefficients (ICCs) were calculated to assess measurement reliability, with >0.75 considered excellent agreement. Subsequent dislocations were noted and patients were divided into two groups: single episode dislocation (group I) and recurrent dislocations (group II). The ability of the TT-TG/PW and TT-TG/TW ratios to predict dislocation recurrence was assessed by calculating odds ratios (OR), C-statistics, sensitivity, and specificity. P values < 0.05 were considered significant.

RESULTS: Mean follow-up was 10.5 years. Forty-eight (55%) patients experienced an isolated patellar dislocation, while 39 (45%) had recurrence. The ICCs of the TT-TG, PW, and TW were 0.9306, 0.9274, and 0.8973, respectively. A TT-TG/TW ≥0.5 was slightly more predictive of recurrent dislocation (OR 3.48, p=0.005) compared to a TT-TG/PW ≥0.4 (OR 2.80, p=0.02).

CONCLUSION: Axial plane patellofemoral joint measurements allow for an individualized assessment of patellar stability. A decreasing trochlear width likely portends a worse prognosis, as this represents less distance the patella must overcome in order to dislocate. These measurements can reliably be obtained. Normalizing the traditional TT-TG measurement to PW and TW values provides individualized risk assessment for future episodes of dislocation. Specifically, a TT-TG/TW value ≥0.5 is a valid indicator of future risk of instability.

Medial Quadriceps Tendon – Femoral Ligament Reconstruction for Patellar Instability: A Technique Description and Short-Term Outcomes

Abstract ID: Paper 027

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OBJECTIVES: The medial quadriceps tendon–femoral ligament (MQTFL) is a distinct structure extending from the distal adductor tubercle to the quadriceps tendon and affords medial support. Anatomic reconstruction of the MQTFL is an alternative to transosseous medial patellofemoral ligament (MPFL) reconstruction for recurrent patellar instability; thus, eliminating concern for patella fracture.

METHODS: Thirteen MQTFL reconstructions were performed between April 2012 and August 2015 for persistent patellar instability that failed non-operative treatment. Included patients had >2+ quadrants of laxity with a history of dislocation. Patients with significant deformity, trochlear dysplasia, or who required a realignment osteotomy were excluded. Anatomic reconstruction of the MQTFL was performed with two variations: (1) suturing the graft into the distal quadriceps tendon, or (2) creating a sling in the medial quadriceps tendon and doubling the graft back. Femoral fixation was performed at the isometric point, just distal to the adductor tubercle, and the graft was tensioned at 60 degrees. We performed a retrospective review of patient characteristics, range of motion, laxity, and short-term clinical outcomes.

RESULTS: Average follow-up was 17 months. Mean patient age was 21 years and half were female. At last follow-up, all patients had 1-2 quadrants of passive lateral glide with a good endpoint. There were no episodes of recurrent instability or dislocation events. All patients attained full range of motion. Eight patients participated in either high school or collegiate athletics and all returned to their preoperative sport. Average Lysholm and Kujala functional scores were both 94.2. Overall satisfaction averaged 95%. There were no significant differences between those repaired with the sling technique or the suture technique.

CONCLUSION: MQTFL reconstruction is a safe and effective procedure for patellar instability. This procedure is a valuable technique for avoiding potential patella fracture associated with transosseous MPFL fixation.

Evaluation of Patient Reported Outcome Measurement Information System in Patients with Patellofemoral Pain

Abstract ID: Paper 028

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BACKGROUND: Patient reported outcomes (PRO) provide subjective evaluation of patient symptoms and quality of life measures. Multiple self-administered instruments exist; however, they have a high patient response burden. The NIH Patient Reported Outcome Measurement Information System (PROMIS) uses computerized adaptive testing (CAT) to provide robust PRO measures, which aims to increase sensitivity to change at extremes of physical function (decreased ceiling and floor effects) while decreasing the survey burden to patients. Our goal was to compare PROMIS physical function CAT (PF-CAT) to validated PROs among a cohort of patients with patellofemoral pain.

METHODS: 13 male and 24 female patients aged 17 to 44 years diagnosed with patellofemoral pain completed the PROMIS PF-CAT, SF36 (physical function= SF36-PF, pain=SF36-Pain, General Health=SF36-GH), Knee Injury and Osteoarthritis Outcome Score (activities of daily living=KOOS-ADL, pain=KOOS-pain, quality of life=KOOS-QOL), Marx Activity Rating Scale, EuroQol-5D (EQ5D), and Kujala score surveys. PF-CAT criterion validity was determined by comparison to SF36-PF. PRO instruments were compared by Spearman's σ. Number of patients with maximum and minimum score was assessed to determine ceiling and floor effect.

RESULTS: PROMIS PF-CAT correlated highest with other measures of physical function including SF36-PF (0.61), KOOS-ADL (0.58) and Kujala (0.59, all $p<0.01$). It also correlated moderately with measures of pain and knee-related sports and QOL ($\sigma = 0.42$ to 0.58, all $p<0.01$). There were no significant correlations between the PF-CAT and the SF36-GH (0.26, $p=0.12$) or Marx score ($\sigma = -0.06$, $p=0.72$). For most patients, the PF-CAT consisted of only 4 questions (98.9%). PF-CAT had zero patients with floor or ceiling effect, whereas every other instrument had at least one patient with floor or ceiling effect.

CONCLUSION: Among patients with patellofemoral syndrome, PROMIS PF-CAT correlates moderately with SF36-PF and other validated PRO instruments. Our results show that there is a lower time-burden with PF-CAT administration and supports the construct validity of the PF-CAT for patients with patellofemoral syndrome.

MAOA BREAKOUT SESSION #3
TRAUMA
April 20, 2017

Reduction Quality After ORIF of Acetabulum Fractures: Surprisingly Low Interobserver Reliability

Abstract ID: Paper 029

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INTRODUCTION: Letournel and Matta have previously described a method for rating the quality of reduction of acetabular fractures on radiographs. While this system has been widely adopted and is prevalent throughout the literature, there is a paucity of evidence on its reproducibility. The purpose of this study was to examine the interobserver reliability for assessing the quality of reduction of acetabular fractures treated with ORIF in order to validate this assessment technique.

METHODS: This is an IRB-approved evaluation of a prospectively collected acetabular fracture database from a single orthopedic trauma surgeon at a level I trauma center. The quality of reduction of all acetabular fractures treated with ORIF between May 2013 and December 2015 was assessed using three standard intraoperative fluoroscopic views (AP and two 45° oblique Judets). Displacement of ≤ 1 mm was considered an anatomic reduction, 2-3 mm imperfect, and > 3 mm poor. A total of 132 acetabular fractures were treated with ORIF during that time period. Twenty-one patients were excluded for incomplete intraoperative flouroscopic imaging and four patients were excluded for acetabular or femoral hardware which obscured the acetabulum on imaging, leaving a total of 107 (81%) patients available for analysis. Acetabular fracture reductions were reviewed by the operative surgeon at time of surgery and subsequently reviewed by two fellowship-trained pelvic/acetabular surgeons. All reduction assessments were performed in a blinded fashion. The primary outcome measure was interobserver reliability for assessing reduction quality. This was evaluated using a weighted kappa (κw) statistic between each reviewer and the operative surgeon and a generalized kappa (κg) for all 3 surgeons. After a 6-week washout period, reduction assessments were performed again to determine intraobserver reliability.

RESULTS: Interobserver reliability among the three orthopedic trauma surgeons showed slight agreement (κg = 0.09). Individual interobserver reliability between the operative surgeon and each other surgeons was also slight (κw = 0.08 & 0.11). Intraobserver reliability was found to be fair for the operative surgeon (κw = .33) and slight and moderate for the other surgeons (κw = .20 & .53).

CONCLUSION: The widely used system described by Letournel and Matta, for assessing reduction quality of acetabular fractures demonstrated only slight interobserver reliability when used by fellowship-trained pelvic/acetabular surgeons. Further studies are necessary to validate

this finding, but these results suggest that a more reliable system may be necessary for the evaluation of the quality of reduction of acetabular fractures.

Hip Joint Instability After Posterior Wall Acetabular Fractures: Are There Identifiable Independent Risk Factors?

Abstract ID: Paper 030

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INTRODUCTION: Posterior wall acetabular (PWA) fractures with unstable hip joints are treated with open reduction and internal fixation. However, the exact anatomic and radiographic determinants of hip instability have yet to be established for fractures involving <50% of the wall. Therefore, examination of the hip under anesthesia (EUA) is routinely used for this determination. Recently, the proximity to the acetabular dome of the cranial posterior wall fracture exit point has been reported to be an important identifiable risk factor. Pre-existing adult hip dysplasia (DDH) is thought to have a similar role. The purpose of this study was to determine if any of the known radiographic fracture characteristics or the radiographic signs associated with pre-existing DDH are independent risk factors for hip instability after PWA fractures.

METHODS: All patients with PWA fractures (OTA 62.A1) treated at our institution between 2004 and 2015 were considered for study. Inclusion criteria were the following: unilateral, isolated PWA fracture involving <50% of the acetabular wall (no other lower extremity or pelvic fractures), adequate radiographs and computed tomography (CT) scans available for review, and documented results of an EUA. The variables evaluated included fracture fragment size, cranial exit point of the fracture, center-edge angle, acetabular index, Tonnis angle, lateralized head sign, crossover sign, posterior wall sign, ischial spine sign, and hip version. Univariate non-parametric statistical analyses of the variables were initially performed. A multivariate logistic regression model was then applied to the significant data to describe the association between measured risk factors and hip instability.

RESULTS: 79 patients were identified as having had an EUA. Eleven were excluded by the selection criteria, leaving 68 patients for study. Univariate analyses identified the posterior wall sign ($p=0.033$), ischial spine sign ($p=0.023$), and fracture proximity to the acetabular dome ($p=0.044$) as having a significant association with hip instability. However, multivariate logistic regression modeling revealed that none of these factors were significant independent risk factors.

CONCLUSION: Consistent with previous studies, univariate analysis showed that certain radiographic findings in PWA fractures were statistically significant risk factors for hip instability. However, the data did not fit subsequent multivariate logistic regression modeling, and none of the studied variables reached statistical significance. The results of this analytic approach indicate that important factors leading to hip instability are yet to be identified or the contributions of the measured ones are relatively small. Therefore, EUA should remain as the main clinical determinant of hip stability status.

Survival of Acute Total Hip Arthroplasty Following a Femoral Neck Fracture: A Multi-Center Study

Abstract ID: Paper 031

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INTRODUCTION: The treatment of femoral neck fractures in the elderly is evolving. With the aging population, there is a growing number of ″active elderly″ that need more durable treatment options. Total hip arthroplasty (THA) has excellent longevity while allowing early mobilization. Historically, there have been concerns regarding the reported high revision rates compared to elective THA. The primary aim of this study was to determine the survival of these THA implants in our community over the last 20 years.

METHODS: Data from a prospectively maintained joint registry from 1992-2014 was reviewed using CPT and ICD9 codes. This data was combined with a retrospective review at two Level 1 Trauma centers from 2005-2014. All fractures were acute in nature. Survival was calculated using the Kaplan-Meier method. Metal on metal implants were excluded.

RESULTS: 237 patients met inclusion criteria. The mean age was 73.2 yrs (+/- 10.5), with 67.5% being female. 77% of cases were performed through a posterolateral approach, 21% anterolateral, and 2% direct anterior. A head size of 36 mm or greater was used in 49.8% of cases. One-year mortality rate was 5.5%. Overall revision rate was 4.6% (6 were for recurrent dislocation, 2 for infection, 2 for peri-prosthetic fracture, and 1 for aseptic loosening). 73% of the revisions were performed in the first year. Average time to revision surgery was 16.5 months. Recurrent dislocation represented 54.5% of the revisions and were revised at a mean of 9.3 months. 80% of those revised (5 of 6) had a head size of 32 mm or less. Five year survival free from revision was 95.1%, ten year survival was 91.9%.

DISCUSSION AND CONCLUSION: With a revision rate of 4.6% and with a 5- and 10-year survival free from revision of 95.1% and 91.9%, respectively, an acute THA for the active elderly with a displaced femoral neck fracture is a good option having results similar to elective hip replacements with a low one year mortality rate.

Thromboprophylaxis for Pelvic Ring and Acetabular Fracture Surgery: How Long is Long Enough After Hospital Discharge?

Abstract ID: Paper 033

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INTRODUCTION: Patients undergoing operative treatment of pelvic ring and acetabular fractures are at high risk for venous thromboembolism (VTE). Published reports indicate that routine postoperative thromboprophylaxis is required and, with few notable exceptions, the use of a pharmacologic agent is the preferred method. However, lack of consensus remains concerning the length of time prophylaxis should be continued after hospital discharge. Recommendations range widely, from a few days to as long as 3 months. A reason for this uncertainty is the paucity of data regarding the occurrence of VTE after a patient's hospital discharge. Since 2004, extended thromboprophylaxis for patients undergoing major orthopedic surgery has been recommended for up to 35 days from the day of surgery. The purposes of this study were to determine the rate of venous thromboembolism (VTE) after discharge from the hospital in patients with a pelvic ring or acetabular fracture treated operatively and to define the main time frame in which VTE occurs within the 90 day period after the patient's hospital discharge.

METHODS: California and Florida State Inpatient Databases (SID) from 2005-2009 were used to identify patients with clinically significant VTEs within 90 days of hospital discharge. These databases were chosen because they contain a unique identifier to track patients over time, ensuring that those with a clinically significant VTE can be found, whether they return to the same hospital or to a different hospital within the state. ICD-9 diagnosis codes identified patients with a pelvic ring or acetabular fracture and a VTE. Procedure codes distinguished patients having surgical treatment for their fracture. The diagnoses of deep vein thrombosis (DVT) and pulmonary embolus (PE) were included.

RESULTS: 13,589 patients were identified as having operative treatment of a pelvic ring or acetabular fracture. 113 patients (0.8%) had a VTE within 90 days after hospital discharge. Of these 113, 85 (0.6%) had a DVT, 44 (0.3%) had a PE, and 16 (0.1%) had both a DVT and a PE. Twenty-four (28%) of DVTs and 10 (23%) of PEs occurred more than 35 days after discharge, being evenly distributed out to 90 days. There were 5 fatal PEs, occurring 2, 3, 7, 31, and 51 days after discharge. Therefore, overall, less than 0.2% of patients developed a DVT and less than 0.1% were diagnosed with a PE more than 35 days after the index hospitalization.

CONCLUSIONS: Although the recommended post-hospital discharge thromboprophylaxis does not completely eliminate VTE risk, the overall occurrence of postoperative VTE after hospital discharge in pelvic ring and acetabular fracture patients is low (0.8%). However, a substantial proportion of these VTE events, including fatal PE, occur over 35 days after discharge. Nonetheless, this finding does not support routinely extending thromboprophylaxis beyond 35 days.

The Effect of the Dedicated Orthopedic Trauma OR Trauma Room on Open Tibia and Femur Fracture Outcomes

Abstract ID: Paper 034

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INTRODUCTION: The ″Dedicated Orthopedic Trauma Operating Room″ (DOTOR) has become a popular way of handling urgent and semi-elective orthopedic trauma cases to efficiently manage cases that would otherwise be unnecessarily delayed. However, delayed management of open fractures could lead to worse outcomes. Our objective was to evaluate patients treated for open lower extremity fractures (femur and tibia) at an academic level 1 trauma center with a DOTOR and its effect on patient outcomes.

METHODS: After IRB approval, a retrospective chart review was conducted identifying a total of 297 patients with 347 open femur or tibia fractures treated at our institution between 2006 and 2011. 154 patients with 174 open fractures of the femur or tibia were treated in the DOTOR and 143 patients with 170 fractures were treated in the (OCOR). Patient demographics including age, ISS, mechanism of injury and timing of arrival and time to surgical intervention were reviewed along with patient outcomes such as time to union, rate of deep infection, nonunion, and reoperations.

RESULTS: For the 154 patients in the DOTOR group, the average time to primary irrigation and debridement was 12 hours and 57 minutes as compared to 5 hours and 22 minutes in the OCOR group. There were 104/154 (67.5%) successful uncomplicated primary fracture unions in the DOTOR group and 81/143 (56.6%) in the OCOR group. The rate of fracture nonunion was 24/154 (15.6%) in the DOTOR group and 34/143 (23.8%) in the OCOR group. Both groups had 12 infected nonunions. 4/143 (2.8%) patients in the OCOR group were eventually treated for malunion as compared to 0 patients in the DOTOR group. Ultimately, 5 DOTOR patients went on to an amputation vs. 10 patients in the OCOR group. Patients initially treated in the DOTOR were twice as likely to go onto uncomplicated primary union (p= 0.003 Fisher′s Exact). Patients in the OCOR group patients were twice as likely to have an unplanned return to the OR (p= 0.018 Fisher′s Exact).

DISCUSSION: Patients with open femur and tibia fractures were more likely to undergo primary I&D within 6 hours of ER admission when treated in the on-call OR. Despite early access to the operating room, these patients were twice as likely to have an unplanned return to the OR. Patients treated in the Dedicated Orthopedic Trauma OR experienced a longer delay to their initial Irrigation and debridement, but were significantly more likely to achieve fracture union. There was no difference in the rate of deep infections between groups.

Working Length and Proximal Screw Constructs in Plate Osteosynthesis of Distal Femur Fractures and the Effect on Union Rate

Abstract ID: Paper 035

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INTRODUCTION: Distal femur fractures, particularly open fractures, have a significant risk of nonunion and hardware failure. As distal femoral locking plates have become popular, few guidelines/recommendations are available to optimize the working length, screw density, etc. when bridge-plating techniques are used to maximize the chances of union. The purpose of this study was to evaluate the working length, proximal screw density, and diaphyseal fixation mode and the correlation to fracture union after locking plate osteosynthesis of distal femoral fractures using bridge-plating technique.

METHODS: Retrospective medical record review. Patients undergoing operative fixation of distal femur fractures with a distal femoral locking plate utilizing bridge-plating technique for the metadiaphyseal region were included. Primary variables included fracture union, secondary surgery for union, plate working length, and diaphyseal screw technique and configuration. Secondary variables included patient demographics, patient comorbidities (tobacco use and diabetes mellitus), injury mechanism, plate metallurgy, OTA fracture type, Gustilo type for open fractures, periprosthetic fracture, and coronal plane fracture alignment.

RESULTS: Ninety-nine patients with distal femur fractures with a mean age 60 years (36 male and 63 female) met inclusion criteria. Mean follow-up was 576 days with 89% follow-up until declared union or 1 year and overall 63% 1 year follow-up. None of the clinical parameters were statistically significant indicators of union. Plate metallurgy, working length, screw density and cortices, and diaphyseal screw technique were not statistically significant indicators of union. Hybrid technique, however, had a statistically significant higher chance of union when compared to locking ($p = 0.03$). All proximal locking screw constructs were 2.7 times more likely to lead to nonunion.

CONCLUSIONS: Stiffer plating constructs when using bridge-plating techniques in distal femur locking plates was associated with a 2.7 higher likelihood of nonunion. Surgeons should consider avoiding the use of all locking screws for diaphyseal fixation in distal femoral locking plates. However, other factors associated with more flexible fixation constructs such as increased working length, decreased proximal screw number, and decreased proximal screw density were not significantly associated with union in this study.

High Incidence Rate of Distal Femur "Golf Club" Deformities Using Contoured Locking Plates

Abstract ID: IPaper 036

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INTRODUCTION: Operative management of distal femur fractures has historically been associated with a high rate of treatment failures, including delayed unions, nonunions, and infections. In an effort to minimize these outcomes, contoured distal femoral locking plates have become popular for treating these fractures. These plates may result in a so-called "golf club" deformity (GCD), which occurs due to posterior placement of the plate on the lateral condyle resulting in medialization of the articular segment. To our knowledge, no prior studies have investigated the incidence of GCDs or the outcomes in patients with such deformities. The aim of this study was to determine the incidence of golf club deformities at our institution and identify associated complications and treatment failures.

METHODS: Between May 2011 and September 2015, 124 patients underwent operative treatment of distal femur fractures with lateral distal femoral locking plates at a level I trauma center. This series included patients treated by five orthopedic trauma surgeons. Based on immediate postoperative films, 33 patients with 35 fractures (2 patients had bilateral fractures) were determined to have GCDs by agreement between an orthopedic trauma surgeon and research fellow. Of these, 13 fractures had insufficient follow-up (<6 months) and were excluded. Patient outcomes were evaluated using the electronic medical records. Outcomes of interest included nonunion, malunion, infection and need for additional surgery.

RESULTS: The overall incidence of GCDs in this series was 28.2% (35/124). Twenty-two of these (62.9%) had a minimum of six months of follow-up and were included in the study, with a mean follow-up of 14 months (range 6-53). Four GCDs (4/22; 18.2%) resulted in nonunions, two of which were treated with bone grafting. One patient that received bone grafting healed and the other went on to subsequent malunion. One patient (1/22; 4.5%) developed osteomyelitis, which resolved following multiple operative interventions. Including those aforementioned procedures, 36.4% of GCDs (8/22) required additional operative interventions. These included removal of hardware (2/22; 9.1%) and manipulation under anesthesia (3/22; 13.6%). Three patients developed post-traumatic arthritis, at a mean follow-up of 19 months.

CONCLUSION: Golf club deformities occurred at a high rate of 28.2% in this series. These deformities were associated with an 18.2% rate of nonunion in our population. Additionally, 36.4% of GCDs required further operative intervention. Further research is needed to validate the incidence rate of GCDs observed in this series and to elucidate the long-term clinical outcomes of these patients through continued follow-up.

The Impact of Intravenous Tranexamic Acid on Pre- and Postoperative Hematocrit in Isolated Operative Acetabular Fractures: A Prospective, Randomized, Double-Blind Pilot Study

Abstract ID: Paper 037

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INTRODUCTION: The purpose of this study was to investigate the effect of tranexamic acid (TXA) on blood loss and transfusion requirements in operatively-treated, isolated acetabular fractures. Based on current literature, we hypothesized that perioperative blood loss and transfusions would decrease in patients treated with TXA compared to those not treated with TXA.

METHODS: This was a prospective, randomized, doubled-blind trial involving patients who sustained a closed, isolated acetabular fracture that required operative intervention. Following IRB approval, a total of 26 patients undergoing surgical fixation at a single Level 1 trauma center for their acetabular fracture were enrolled. Patients were randomized to either treatment [TXA] or control [CNT] groups. The TXA group received 15 mg/kg TXA in 100 mL normal saline IV five minutes prior to the start of surgery whereas the CNT group received 100 mL normal saline placebo in a similar fashion. The primary outcome measure was perioperative blood loss (hematocrit reduction and calculated blood loss). Secondary outcomes measures included transfusion and thromboembolic event occurrence. Differences between TXA and CNT cohorts were compared using Student's t-tests and chi square tests for continuous and categorical variables, respectively.

RESULTS: Twelve patients were randomized to TXA group while 14 patients were randomized to CNT group. No differences were observed between TXA and CNT in regard to gender, age, body mass index (BMI), diabetes status, interval to surgery, fracture pattern (elementary vs. associated), approach (percentage of Kocher-Langenbeck vs. other approaches), and operative time ($p > 0.05$ for all variables). With regard to the primary outcome of perioperative blood loss, neither the pre- and postoperative hematocrit change nor the calculated blood loss (CBL) were significantly different between the cohorts (TXA HCT delta: 5.90; CNT HCT delta: 4.15; $p = 0.94$) and (TXA CBL: 487 mL; CNT CBL: 279 mL; $p = 0.37$). In addition, the number of units of blood transfused in the operative room was similar between groups ($p = 0.52$), as was the occurrence of thromboembolic events ($p = 0.53$).

DISCUSSION AND CONCLUSION: This pilot study does not support the routine utilization of IV TXA in individuals undergoing operative intervention for closed, isolated acetabular fractures. Further studies should be performed to further evaluate the use of TXA in acetabular fractures, especially considering controversial findings in the trauma and elective orthopedic literature.

Serum Albumin Predicts Survival and Postoperative Course Following Surgery for Geriatric Hip Fracture

Abstract ID: Paper 038

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INTRODUCTION: Malnutrition is a potentially modifiable risk factor that may contribute to complications following geriatric hip fracture surgery. While prior studies have identified associations between malnutrition, delayed wound healing, and surgical site infection (SSI), the evidence remains controversial, and associations between malnutrition and other complications have not been investigated. The purpose of this study was to investigate the association between preoperative hypoalbuminemia, a marker for malnutrition, and complications during the 30 days following surgery for geriatric hip fracture.

METHODS: The American College of Surgeons National Surgical Quality Improvement Program was used to conduct a retrospective cohort study of geriatric patients (≥65 years) undergoing surgery for hip fracture. Outcomes were compared between patients with and without hypoalbuminemia (defined as serum albumin concentration <3.5g/dL). All comparisons were adjusted for baseline differences between populations.

RESULTS: 17,651 patients with serum albumin concentration available were identified. Of these, 8,272 (46.9%) underwent hemiarthroplasty, 759 (4.3%) total joint arthroplasty, 324 (1.9%) percutaneous fixation, 2,445 (13.9%) plate/screw fixation, and 5,833 (33.1%) intramedullary fixation. The prevalence of hypoalbuminemia was 45.9%. The risk for death was strongly associated with serum albumin concentration, with a linear increase in risk observed as albumin fell below 3.5 g/dL ($p<0.001$). Following adjustment for all demographic, comorbidity, and procedural characteristics, patients with hypoalbuminemia had higher rates of death (9.94% vs. 5.53%, adjusted relative risk [RR]=1.54, $p<0.001$), cardiac arrest requiring resuscitation (1.10% vs. 0.62%, adjusted RR=1.41, $p=0.045$), pneumonia (5.30% vs. 3.77%, adjusted RR=1.20, $p=0.012$), sepsis (1.19% vs. 0.53%, adjusted RR=1.90, $p<0.001$), unplanned intubation (2.64% vs. 1.47%, adjusted RR=1.52, $p<0.001$), and hospital readmission (10.91% vs. 9.03%, adjusted RR=1.11, $p<0.036$).

CONCLUSIONS: The present study suggests that hypoalbuminemia is a powerful independent risk factor for death following surgery for geriatric hip fracture. This association persists over and above any associations of death with age, sex, body mass index, and comorbidities. Based on these data, we propose that the nutritional status of hip fracture patients should receive greater attention, and that randomized trials testing for efficacy of aggressive postoperative nutritional interventions may be warranted.

Is Scheduled Perioperative Intravenous Acetaminophen Use in Geriatric Hip Fractures Cost-Effective?

Abstract ID: Paper 039

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PURPOSE: The elderly population of the United States continues to rise, resulting in an expected increase in the number of hip fractures. Steps need to be taken to make medical treatment decisions that are both efficacious and economically responsible. Scheduled intravenous (IV) acetaminophen has been shown be beneficial in managing pain in orthopedic surgery and improving outcomes in geriatric hip fracture patients. The purpose of this study was to evaluate the cost-effectiveness of scheduled IV acetaminophen use in geriatric patients with a hip fracture.

METHODS: A retrospective review of all patients 65 years and older admitted to a Level 1 trauma center who received operative treatment for a hip fracture (AO/OTA 31-A, 31-B) over two years. Demographic data, in-hospital variables, outcome measures, and hospital billing data (broken down by department) were analyzed. 330 consecutive fractures in 326 patients met inclusion criteria. These patients were divided into two cohorts. Group 1 (165 fractures) consisted of patients treated before the initiation of a standardized IV acetaminophen perioperative pain-control protocol, and Group 2 (165 fractures) consisted of those treated after the protocol was initiated.

RESULTS: Group 2 had significantly lower mean length of hospital stay (3.8 vs. 4.4 days, $p<0.001$), visual analog scale pain score (4.2 vs. 2.8, $p<0.001$), and narcotic use (41.3 vs. 28.3mg, $p<0.001$). With billing data broken down by department, group 2 had lower mean total cost of hospital bed (-24.7%, $5758 vs. $7181, $p<0.001$), decreased pharmacy expense (-21.1%, $2104 vs. $2549, $p=0.05$), and decreased total cost of hospitalization (-8.0%, $27171 vs. $29345, $p=0.05$). Group 2 had an increase in cost of supplies and implants of (14.8%, $4509 vs. $3843, $p<0.001$) and operating room services (7.0%, $5472 vs. $5090, $p=0.03$). When accounting for these increased supply costs, the overall cost of hospitalization was decreased 20.2% for group 2 (-20.2%, $16967 vs. $20386, $p<0.001$). There was positive correlation between length of stay and cost of bed ($r=0.61$, $p<0.001$) and length of stay and total cost of hospitalization ($r=0.53$, $p<0.001$). There was no significant correlation between use of IV acetaminophen and total cost ($r=-0.06$, $p=0.28$) or use of IV acetaminophen and pharmacy cost ($r=-0.02$, $p=0.72$).

CONCLUSION: Scheduled IV acetaminophen for geriatric hip fractures resulted in decreased length of hospital stay, which correlated with decreased cost of hospitalization, and improved pain control and lower narcotic use without increase in pharmacy cost. IV acetaminophen use can improve outcomes in geriatric hip fractures cost-effectively.

Hypovitaminosis D: Which Guidelines for Baseline Supplementation Should Be Followed?

Abstract ID: Paper 040

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PURPOSE: Hypovitaminosis D is prevalent among orthopedic trauma patients and is a risk factor for fragility fractures as well as bone healing complications. The Institute of Medicine recommends 400 International Units (IU) daily while the Endocrine Society recommends a higher dose (2000 IU daily). The objectives of this study were to prospectively evaluate risk factors for hypovitaminosis D in an orthopedic trauma population and to determine the level of baseline supplementation associated with normal vitamin D levels at presentation.

METHODS: A prospective observational study was performed in patients undergoing operative treatment for orthopedic trauma at a level 1 trauma center (January to December, 2014). Levels of 25-hydroxy vitamin D (25-OH D) were obtained for 259 patients. Patient and injury characteristics were recorded including age, sex, race, insurance, smoking, BMI, comorbidities, pre-injury supplementation, and low vs. high energy mechanism. Prevalence of insufficiency (25-OH D < 30ng/ml) and deficiency (25-OH D < 20ng/ml) were determined. Univariate analyses of patient and injury characteristics determined associations with hypovitaminosis D and multivariate logistic regression analysis assessed for independent associations.

RESULTS: Among 259 patients, 191 (73.7%) were vitamin D insufficient and 109 (42.1%) were deficient. On multivariate analysis, only pre-injury supplementation (odds ratio 0.33, 95% CI 0.16 – 0.71, p = 0.004) and non-white race (odds ratio 4.58, 95% CI 1.94 – 10.79, p = 0.001) were independently associated with hypovitaminosis D. The 25-OH D level demonstrated a dose-dependent association with baseline vitamin D supplementation. Among those on supplementation, the prevalence of insufficiency was 9 of 11 (81.8%) for < 500 IU daily, 17 of 31 (54.8%) for 500 to 1000 IU daily, 8 of 18 (44.4%) for 1000 to 2000 IU daily, and 4 of 16 (25%) for > 2000 IU daily. Deficiency (25-OH D < 20ng/ml) was 4 of 11 (36.4%) for < 500 IU daily, 6 of 31 (19.4%) for 500 to 1000 IU daily, 2 of 18 (11.1%) for 1000 to 2000 IU daily, and 1 of 16 (6.3%) for > 2000 IU daily.

CONCLUSIONS: Lack of pre-injury supplementation and non-white race were independently associated with hypovitaminosis D. Vitamin D supplementation when present at a sufficient dose was associated with a very low rate of vitamin D deficiency. Given hypovitaminosis D remained prevalent for supplementation less than 1000 IU daily, baseline supplementation consistent with recommendations from the Endocrine Society (2000 IU daily) appears most effective in this population.

MAOA BREAKOUT SESSION #4
HIP AND KNEE ARTHROPLASTY
April 20, 2017

Concurrent Total Joint Arthroplasty Does Not Put Patients at Higher Risk of Complications

Abstract ID: Paper 041

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INTRODUCTION: Concurrent or overlapped total hip arthroplasty (THA) and total knee arthroplasty (TKA) is a common practice in the academic setting, allowing for improved efficiency and a more hands on experience for training surgeons. There may be negative implications to such practice assuming outcomes can be suboptimal. The aim of this study was to evaluate the association between concurrent surgeries and patient outcomes (i.e., development of venous thromboembolism [VTE], wound complications, hemorrhage or hematoma/seroma, and infections) in primary THA and TKA.

METHODS: All primary THAs and TKAs performed between 2005- 2014 at a large academic hospital were retrospectively reviewed (N=9,192). In the absence of a universal definition for concurrent surgeries, it was defined in this study as incision to closure overlap time of at least 1 minute. N=2.669 (29%) patients had a concurrent surgery. Patient demographic and perioperative variables including operative times, and 90-day complications were collected from electronic medical records. Mixed effects regression modeling was used to account for variations at the level of surgeon in addition to adjusting for age, gender, BMI, age-adjusted Charlson score, and surgery type.

RESULTS: After adjusting for the surgeon-level variations and patient factors, including age, gender, BMI, Charlson score, and surgery type, operative time was longer for concurrent surgeries (3.31, per unit increase, 95% confidence interval [CI] 1.48- 5.13, $p<0.001$) and concurrent surgeries did not increase the risk for wound complications (odds ratio [OR]=1.12, 95%CI 0.67- 1.89, p=0.66), wound infections (OR=0.77, 95%CI 0.54- 1.11, p=0.16), or hemorrhage or hematoma/seroma (OR=1.29, 95%CI 0.61- 2.73, p=0.51); additionally, VTE (OR=0.65, 95%CI 0.49- 0.87, p=0.003) and PJI (OR=0.65, 95%CI 0.43- 0.98, p=0.039) were less likely to occur in the concurrent surgery group.

CONCLUSION: Compared to non-concurrent THA and TKA, concurrent surgeries had increased operative time, but no significant increase in wound complications, infections, VTE, or hemorrhage or hematoma/seroma. This information may help to plan scheduling of concurrent procedures and counsel patients about this issue in teaching hospitals.

Hip and Knee Arthroplasty in the Outpatient vs. Inpatient Setting

Abstract ID: Paper 042

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INTRODUCTION: Outpatient hip and knee arthroplasty procedures have become more common; however, few studies have compared morbidity following outpatient and inpatient procedures. The aims of the present study were to compare matched cohorts of hip or knee arthroplasty patients in terms of postoperative complications and 30-day readmission.

METHODS: Patients who underwent primary elective total hip arthroplasty (THA), total knee arthroplasty (TKA), or unicompartmental knee arthroplasty (UKA) from 2005 to 2014 were identified from the prospectively collected National Surgical Quality Improvement Program (NSQIP) registry. A total of 1,236 patients discharged the day of surgery were matched using propensity scores to patients who had an inpatient stay. Among procedures, 49.2% were TKAs, 29.8% were THAs, and 21.0% were UKAs. The rates of 30-day adverse events and readmission were compared between matched cohorts using McNemar's tests. Risk factors for readmission following outpatient hip and knee arthroplasty were identified using multivariate regression.

RESULTS: There were no differences in overall adverse events (p=0.106) or readmission (p=0.891) between outpatient and inpatient groups, although inpatients had a higher rate of thromboembolic events (p=0.048) and outpatients had a higher rate of return to the operating room (p=0.016). Insulin-dependent diabetes (relative risk [RR] 3.4, p=0.047), non-insulin dependent diabetes (RR 2.9, p=0.020), and age 85 years or older (RR 6.6, p=0.025) were found to be risk factors for 30-day readmission following outpatient hip or knee arthroplasty. Infection was the most common reason for reoperation and readmission following outpatient procedures.

CONCLUSION: No differences in overall postoperative complications or readmission were found between matched cohorts of outpatient and inpatient hip and knee arthroplasty patients. Patients with diabetes mellitus and those aged 85 years or older were at significantly increased risk of 30-day readmission following outpatient procedures.

The Use of Fluoroscopy During Direct Anterior Hip Replacement: Powerful or Misleading?

Abstract ID: Paper 043

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INTRODUCTION: Direct anterior approach (DAA) total hip arthroplasty (THA) allows supine positioning with fluoroscopic assistance. However, pelvic tilt and patient positioning can affect accurate assessment of implant positioning. This study evaluates the effect of key variables on perceived acetabular position during DAA THA with fluoroscopy.

METHODS: A prospective cohort of 30 hips in 28 patients underwent DAA THA with fluoroscopy and evaluated by postoperative radiographs and CT. The acetabular component position as defined by three-dimensional CT reconstruction was compared to measurements made from intraoperative fluoroscopy and plain radiographs. Data were assessed for statistically significant ($p<0.05$) differences.

RESULTS: Supine pelvic tilt measured by CT ranged from 6° of flexion to 19° of extension (mean= 2.3° of extension + 6.6°), significantly varying from the anterior pelvic plane ($p=0.0003$).

Symphysis to coccyx distance is a common method of assessing sagittal orientation of the pelvis, but was highly variable even when pelvic tilt was corrected to the anterior pelvic plane. This distance averaged 0.3 cm, ranging from 3.5 cm below the symphysis to 2.2 cm above.

Acetabular cup anteversion ($p=0.43$; power=0.75) and inclination ($p=0.28$; power=0.6) measured by intraoperative AP fluoroscopy were accurate measures compared to CT reconstructions of the intraoperative pelvic tilt. Crosstable lateral radiograph, however, is not an accurate measure of anteversion ($p=0.045$).

DISCUSSION: Supine DAA THA allows for the use of fluoroscopic imaging with ease. When employed properly, intraoperative imaging allows the surgeon to confirm accurate component placement. Pelvic tilt affects the perceived position of the acetabular component and cannot be accurately compensated for by assessing the relationship between the coccyx and the symphysis. We recommend positioning the c-arm so the size and shape of the obturator foramen matches the preoperative AP image. This technique allows the patient’s native pelvic tilt to be accounted for intraoperatively, making intraoperative fluoroscopic assessments accurate for determining acetabular component orientation.

Functional Outcome Scoring Data Quality in Total Joint Arthroplasty

Abstract ID: Paper 044

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INTRODUCTION: Outcome measures following total hip arthroplasty (THA) and total knee arthroplasty (TKA) have been traditionally recorded for research purposes. Increasingly, outcome measures have a critical role in the practice of THA and TKA due to evolving payment models and a growing emphasis on healthcare value. This study sought to identify the extent to which data required for two well-established outcome measures were recorded at a single academic institution, prior to the creation of a data collection protocol.

METHODS: Pre- and postoperative clinical appointments of over 450 randomly selected patients undergoing THA or TKA from 2009-2012 were reviewed. Components of the Harris Hip Score (HHS) and the American Knee Society Score (AKSS) were marked as present or absent from the medical record. Percentages of missing HHS and AKSS data components and patient follow-up were determined.

RESULTS: Only 32% of HHS variables were collected at the preoperative visit for patients undergoing THA. Early postoperative visits following THA recorded data at rates less than 24%, with only 26% of variables collected at the one-year postoperative visit. For elective TKA, preoperative visits collected only 29% of AKSS variables. Early postoperative visits recorded less than 30% of AKSS variables and this fell to 23% at the one-year postoperative visit. Follow-up for THA and TKA patients was similarly poor, with only 53% of THA and TKA patients returning for 1-year postoperative visits.

CONCLUSION: Less than one-third of the data needed to formulate a HHS or AKSS was recorded at any completed office visit. The collection of data necessary for outcome measures will require increased efforts, in terms of both time and expense, over the traditional office visit for a patient undergoing THA or TKA. Additionally, poor patient follow-up poses a potent challenge to meeting proposed collection requirements.

ABO Blood Group is a Predictor for the Development of Venous Thromboembolism Following Total Joint Arthroplasty

Abstract ID: Paper 045

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BACKGROUND: The current ability to predict which patients will suffer from a venous thromboembolism (VTE) following total joint arthroplasty (TJA) is relatively inadequate. The ABO blood group has been associated with development of VTE. This study's purpose was to test whether there is an association between patient's ABO blood group and the development of symptomatic VTE within 90 days following TJA.

METHODS: All primary TJA patients from a single healthcare system between 2000- 2014 (n=30,109) were retrospectively reviewed. Of these, 28,025 patients had a recorded ABO blood group. Patient demographics, comorbidities, and perioperative data were collected from the electronic medical records and compared, stratified by symptomatic VTE development and then by ABO blood groups. Patients who experienced a symptomatic VTE confirmed by ultrasound or computerized tomography scan within 90 days of surgery were identified (N=887). Multivariable regression models were adjusted for other potential risk factors, including age, gender, Body Mass Index (BMI), surgery type, previous VTE, smoking status, rheumatologic diseases, malignancy, hypercoagulable state, and postoperative VTE prophylaxis in order to test the association of ABO blood groups and development of a postoperative VTE.

RESULTS: Multivariable regression analysis found that the AB blood group significantly increased the odds for developing a symptomatic VTE following TJA (odds ratio[OR]=1.4, 95% confidence interval [CI] 1.02- 1.89, p=0.03). Additional risk factors for symptomatic VTE following TJA were age (OR=1.02, 95% CI 1.01- 1.03, p<0.001), BMI (OR=1.02, 95% CI 1.01- 1.03, p<0.001), history of VTE (OR=4.87, 95% CI 4.11- 5.76, p<0.001), malignancy (OR=1.46, 95% CI 1.23- 1.73, p<0.001), hypercoagulable state (OR=3.01, 95% CI 2.13- 4.20, p<0.001), non-aspirin anticoagulant (OR=1.54, 95% CI 1.17- 2.1, p=0.002), and TKA (OR=1.3, 95% CI 1.12- 1.50, p=0.001).

CONCLUSIONS: The AB blood group was associated with a significantly increased risk for developing a VTE following primary TJA. A patient's ABO blood group should be considered in terms of risk stratification and selection of appropriate postoperative VTE prophylaxis.

Intraoperative Chlorhexidine Irrigation to Prevent Infection in Total Hip and Knee Arthroplasty

Abstract ID: Paper 046

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Infections continue to be a devastating complication in total joint arthroplasty (TJA). Several studies have suggested that intraoperative irrigation can potentially reduce the rate of infection. The effectiveness of intraoperative chlorhexidine gluconate (CHG) irrigation has yet to be described. The purpose of this study was to assess infection following TJA with intraoperative CHG irrigation, compared to saline and betadine. We performed a retrospective cohort analysis of 1050 patients that underwent TKA/THA by a single surgeon from February 2012 to October 2015. After excluding patients with incomplete data, 906 patients were ultimately included. There were 411 TKA and 253 THA patients in the control group while 248 TKA and 138 THA patients in the CHG group, approaching a 2:1 ratio, respectively. THA performed prior to September 2014 (N=664) underwent irrigation with betadine, while TKA patients underwent irrigation with normal saline. After October 2014 (N=386), all patients received irrigation with CHG solution. Nonsurgical site infections (NSSI), superficial surgical site infection (SSSI), and deep surgical site infection (DSSI) rates between the two groups were compared. Patient demographics were included. Statistical analysis was performed using adjusted odds ratios at a 95% confidence interval and univariate repeated-measures logistic regression models ($P<0.05$). There was no statistically significant association in infection rates between control and chlorhexidine irrigation solutions. Odds ratio and 95% confidence intervals between treatment groups were 1.97 ([0.97,3.97] p=0.059), 1.75 ([0.35,8.70] p=0.4940, and 1.36 ([0.35,5.29] p=0.6757) for NSSI, SSSI, and DSSI, respectively. The two groups had no statistical difference in age, BMI, procedure (TKA/THA) side, or gender. Two patients were excluded from the CHG irrigation group due to traumatic knee injury associated with fall. The use of intraoperative chlorhexidine irrigation during TJA has a comparable infection rate to the current protocols using betadine for THA and normal saline for TKA.

Empiric Treatment Less Costly than S.aureus Screening and Decolonization in Hip and Knee Arthroplasty Patients

Abstract ID: Paper 047

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INTRODUCTION: Nasal S. aureus colonization increases the likelihood of total joint arthroplasty (TJA) infection, and this has prompted preoperative screening and decolonization of S. aureus carriers. The most cost-effective protocol for S. aureus decolonization has not been established. The aim of our study was to compare the cost of empiric treatment of all TJA patients with that of standard screening and decolonization.

METHODS: We compared cost of empiric treatment of all TJA patients with intranasal mupirocin twice daily for 5 days with cost of a S. aureus screening and decolonization protocol that included nasal swab, surgeon review of all results, medical assistant (MA) notification of patients with positive results, and treatment of patients who tested positive.

The cost of empirically treating a patient with mupirocin is $22/patient. Surgeon time required to sign a standing order for this medication was considered negligible.

The cost of S. aureus screening and decolonization is as follows: $51/patient for lab fees; $3.42/patient for surgeon time assuming 1 minute to review results, $589,267/year salary, 48 weeks worked/year, and 60 hours worked/week; $2.65/S.aureus positive patient for MA time assuming 10 minutes to counsel patient and MA salary of $15.92/hour; and $22/S. aureus positive patient for mupirocin treatment. 23% of TJA patients at our institution test positive for S. aureus.

RESULTS: In a high-volume TJA practice of 500 surgeries/year, cost of empiric treatment is $11,000/year while cost of S. aureus screening and decolonization is $30,044.75/year.

Assuming 1,051,000 TJA performed nationally each year, cost savings with empiric treatment over screening and decolonization is $40,032,064.50/year.

CONCLUSIONS: Empiric treatment of TJA patients with mupirocin would save our health care system over $40 million annually compared to S. aureus screening and decolonization. An added benefit of empiric treatment is avoidance of laboratory error and human error in result interpretation with screening and decolonization.

Survival Improves with Increased Antibiotic Duration After Total Knee Arthroplasty Irrigation and Debridement

Abstract ID: Paper 048

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INTRODUCTION: The optimal duration of antibiotic therapy following total joint arthroplasty irrigation and debridement (I&D) with modular component exchange has not yet been established. Our aim was to determine if antibiotic duration affects infection-free survival following total knee arthroplasty (TKA) I&D with liner exchange.

METHODS: We retrospectively reviewed patients at our institution who underwent TKA I&D with liner exchange for acute hematogenous infection from 2007 to 2012 with minimum 2-year follow-up. Infecting organism, duration of antibiotic therapy, reoperation for infection recurrence, patient demographics, co-morbidities, and surgical factors were recorded. Fisher's exact test, Chi-square test, and Student's t-test were utilized to compare factors between patients with and without infection recurrence. Multivariate survival analysis using Cox regression was built to examine association between duration of antibiotics and infection-free survival. Variables significant in univariate analysis, as well as demographic and clinical factors, were controlled in the Cox model. With a hazard ratio of 0.50, the power to detect an effect of antibiotic duration on infection-free survival was 0.80.

RESULTS: From 2007 to 2012, there were 76 patients who underwent TKA I&D with liner exchange. 21 patients (28%) required reoperation for infection recurrence. Longer duration of antibiotics was associated with infection-free survival [hazard ratio 0.99, 95%CI 0.981-0.998, p=0.0214]. Patients with S. aureus infection were more likely to have recurrent infection than with other infecting organisms [hazard ratio 4.009, 95% CI 1.399-11.485, p=0.0097]. Chronic inflammation on intraoperative pathology decreased likelihood of recurrent infection [hazard ratio 0.119, 95% CI 0.020-0.717, p=0.0202], while atrial fibrillation increased likelihood of recurrent infection [hazard ratio 3.942, 95%CI 1.338-11.616, p=0.0128].

CONCLUSIONS: Our study suggests infection-free survival following TKA I&D with liner exchange improves with longer antibiotic duration. Chronic antibiotic suppression should be considered in appropriate patients. Two-stage exchange may be favored in patients with S. aureus infection or history of atrial fibrillation.

Gender Differences for Hip and Knee Arthroplasty: Complications, Costs, and Length of Stay

Abstract ID: Paper 049

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INTRODUCTION: The influence of patient gender on postoperative complications and healthcare utilization remains unexplored for total hip arthroplasty (THA) and total knee arthroplasty (TKA). The present study aimed to determine if patient gender significantly affected outcomes following these procedures.

METHODS: A retrospective cohort study of THA and TKA patients was performed using the Nationwide Inpatient Sample (NIS) from 2002 to 2011. Only patients that underwent primary elective procedures and those with complete perioperative data were included. Multivariate regression was used to compare the rates of adverse events, length of stay, and total hospital costs between male and female cohorts while controlling for patient demographics, comorbidities, and procedure type. A total of 6,123,637 patients were included (31.2% THA and 68.8% TKA). The cohort was 38.9% male.

RESULTS: Using multivariate regression, while males had a lower rate of any adverse event (OR 0.8, $p<0.001$) and urinary tract infection (OR 0.4, $p<0.001$), male gender was associated with statistically significant increases in the rates of multiple individual adverse events including death (OR 1.6, $p<0.001$), cardiac arrest (OR 1.7, $p<0.001$), pneumonia (OR 1.1, $p<0.001$), sepsis (OR 1.6, $p<0.001$), surgical site infection (OR 1.3, $p=0.003$), and wound dehiscence (OR 1.4, $p<0.001$). Male gender was also associated with a small decrease in length of stay (-0.1 days, $p<0.001$) and a minor increase in inpatient costs ($219, $p<0.001$). Among THA patients alone, there was no gender difference in the rate of dislocation ($p=0.530$).

CONCLUSION: Males had increased rates of many individual adverse events, such as death, cardiac arrest, sepsis, surgical site infection, and wound dehiscence. Females had higher rates of urinary tract infection and transfusion which given their frequency, translated to an overall higher rate of adverse events. While there were statistically significant differences in length of stay and costs, these were unlikely to be clinically important.

Does the Obese Population Have More Unfavorable Perioperative Outcomes Compared to the Non-Obese Population Undergoing Primary Total Hip Arthroplasty?

Abstract ID: Paper 050

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INTRODUCTION: The incidence of both obesity and primary total hip arthroplasty (THA) is on the rise in the United States. While an increased rate of periprosthetic infection in obese patients undergoing THA has been shown in the literature, differences in other perioperative outcomes in obese patients have not been well analyzed. The purpose of this study was to evaluate perioperative outcomes for primary THA in obese patients.

METHODS: The National Hospital Discharge Survey database was searched using ICD-9 codes for patients admitted to U.S. hospitals for primary THA between 2001-2010. Obese patients were identified by ICD-9 codes. ICD-9 codes were then used to analyze patient demographics, discharge disposition, and in-hospital adverse events. Statistical analysis included linear regression with Pearson's correlation coefficient (r), Student's t-test, and chi-square analysis.

RESULTS: 1,243 obese and 16,944 non-obese THA patients were identified. The obese group had a mean patient age of 60.1 years significantly lower than 65.6 years in the non-obese group ($p<0.01$). Women accounted for 60.1% of the obese group vs. 56.4% in non-obese patients ($p<0.01$). Obese patients accounted for 5.90% of the THA performed between 2001-2005 and significantly increased to 9.04% between 2006-2010 ($p<0.01$). After adjusting for fluctuations in annual hospital admissions, both the obese and non-obese groups demonstrated strong positive correlations with time with r values of 0.95 and 0.80, respectively. The average hospitalization was significantly longer for the non-obese group (4.0 vs. 3.5 days, $p<0.01$). The rate of discharge to home was significantly higher in obese patients (51.1% vs. 47.1%, $p<0.01$). The rates of PE (non-obese 0.25% vs. obese 0.16%, $p=0.71$), and DVT (0.08% vs. 0.16%, $p=0.69$) were not significantly different. The blood transfusion rate was significantly greater in non-obese patients (26.1% vs. 23.4%, $p=0.04$). No significant difference in mortality was found (non-obese 0.23% vs. obese 0.08%, $p=0.44$).

CONCLUSIONS: This study demonstrates that the proportion of patients in the U.S. undergoing a THA that are obese is significantly increasing with time. The obese THA patients interestingly had a more favorable discharge disposition, shorter LOS, and equivalent rate of in-hospital complications. While the increased rate of periprosthetic infection in obese patients undergoing THA is a serious increased risk, this study did not demonstrate worse perioperative outcomes in this growing population.

Are We Still Prescribing Opioids for Osteoarthritis?

Abstract ID: Paper 051

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INTRODUCTION: The U.S. is in the midst of an opioid epidemic. A recent Cochran Review has concluded that opioids have a minimal effect on pain or function for patients with osteoarthritis (OA). Overall, little is known regarding how often these medications are prescribed for management of OA symptoms. The purpose of this study was to identify rates of opioid prescription for any joint OA, hip OA, and knee OA; and to evaluate the impact of patient demographics and geographic location on their use.

METHODS: The Humana Inc. dataset was reviewed from 2007-2015. This represents over 20 million lives. Patients with any joint OA, hip OA, and knee OA were identified by ICD-9 codes. Cohorts were further divided based upon history of an opioid prescription for the OA type of interest. Rates of opioid prescriptions for any joint OA, hip OA, and knee OA were trended throughout the years of the dataset. Additionally, impact of patient age, sex, and geographic location on opioid use for hip and knee OA were calculated utilizing odds ratios (OR) and 95% confidence intervals.

RESULTS: In total, 2,441,882 patients with any joint OA, 863,573 patients with hip OA and 1,025,351 patients with knee OA were analyzed. Overall, 19.1% of any joint OA patients had received an opioid prescription for their OA. 15.6% of patients with hip OA and 18.1% of patients with knee OA had received opioids for their respective OA. Rates of opioid prescriptions remained stable over the years for all cohorts. Patients under 50 years old were more likely to receive opioids for hip OA (23.6% vs. 15.2%, OR: 1.7 [1.6-1.8], $p<0.001$) and knee OA (24.7% vs. 17.7%, OR: 1.5 [1.5-1.6], $p<0.001$). Additionally, males were more likely to receive opioids for their respective OA (hip OA: 1.1 [1.04-1.1], knee OA: 1.03 [1.02-1.04]). There were large regional variations in rates of opioid prescriptions for hip and knee OA with the most pronounced differences between the South and the Northeast.

CONCLUSIONS: Despite no compelling evidence supporting use of opioids of OA symptoms, opioids continue to be prescribed frequently for any joint OA (19%), hip OA (16%), and knee OA (18%). Additionally, they are prescribed more frequently in certain populations and geographic locations. This data provides an important baseline as we all work to combat the opioid epidemic and highlights concerns of increased opioid prescribing in certain populations that will need to be evaluated with further research.

Prediction of Lower Extremity Shape from BMI in Obese Patients

Abstract ID: Paper 052

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INTRODUCTION: Obesity is increasingly recognized as a major risk factor for adverse outcomes in total knee and hip arthroplasty. Despite being at its most base level an aberration of body weight, very little is known about the local biomechanics of the prosthetic joint in the setting of obesity. In addition to increased loading, increased lower extremity girth is hypothesized to lead to alterations in locomotion, as well as predisposing to soft-tissue impingement which may increase localized stresses within the knee and hip joint. Additionally, recent data support that specific patterns of adipose tissue distribution may predispose to adverse outcomes in TKA. Unfortunately, our scientific understanding of fat distributions has not expanded beyond the 50-year old recognition of 'somatotype' and 'morphotype' forms. Therefore, we developed a novel computational method to predict the specific lower extremity shape from sex and body mass index (BMI).

METHODS: AP/lateral knee and long-leg AP/lateral x-rays were obtained from 252 patients undergoing primary TKA. Custom-algorithms were developed to generate best-fit ellipses of the soft-tissue envelope from the AP and lateral long-leg films. Elliptical parameters (major and minor axes) were averaged as a function of BMI. Similarly, the anteroposterior thickness of adipose tissue anterior to the patella (pre-patellar) and tibial tubercle (pre-tibial) were measured.

RESULTS: Lower extremity girth increased with increased BMI. While overall distributions of adipose tissue varied between males and females, maximal girth was comparable between the two groups. In general, anteroposterior distribution was more sensitive to BMI than adipose tissue distributed in the mediolateral directions. In general, pre-patellar and pre-tibial measurements were higher in females across the entire BMI range.

DISCUSSION: Accurate representation of lower extremity adipose distribution is important not only for permitting precise computational assessment of joint biomechanics in obese patients, but also to predict possible adverse outcomes following TKA. This novel study considerably expands our knowledge-base of lower extremity shape in obese patient beyond simple morphotype analysis, and is an important first-step for developing robust computational modelling analyses of the biomechanics of obese total joint patients.

MAOA BREAKOUT SESSION #5
Tumor/Education/Practice Management
April 20, 2017

Treatment of Metastatic Lesions of the Femoral Head and Neck: A Survey of the Members of the Musculoskeletal Tumor Society

Abstract ID: Paper 053

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BACKGROUND: Metastatic disease involving the femoral head and neck is often treated with a hemiarthroplasty or total hip arthroplasty (THA) to prevent pathologic fracture. This investigation seeks to identify the current practices of orthopedic oncologists with regard to implant choices when treating metastatic lesions of the femoral head and neck.

METHODS: This investigation was designed as an online survey of the members of the Musculoskeletal Tumor Society (MSTS). The investigation was reviewed by our Institutional Review Board and deemed exempt. The survey contained surgeon demographic questions and 7 clinical vignettes with identical imaging of a pathologic lesion of the femoral head and neck. The primary outcome measured was decision to treat the lesion with hemiarthroplasty or THA. Secondary outcomes measured were the reason for each treatment decision and the use of monopolar or bipolar hemiarthroplasty. Member responses were analyzed by surgeon demographic characteristics. Pairwise Kappa statistics were used to determine the inter-observer reliability on primary treatment decision of hemiarthroplasty compared to THA.

RESULTS: A total of 93 (30.0%) members of the MSTS completed the survey. Overall, the responses in the cases of younger patients with only skeletal metastatic disease and a favorable histologic subtype indicated a lack of agreement between treatment with THA or hemiarthroplasty, with 40.9%, 52.7%, and 32.3% of respondents choosing THA, respectively. On a rank scale, decreased risk of dislocation was identified by respondents as the most important reason for choosing hemiarthroplasty, while improved pain and functional outcome was most important for THA. Completion of an arthroplasty fellowship or maintaining an elective arthroplasty practice was rarely a significant predictor of treatment decision. When a hemiarthroplasty was chosen, most respondents reported using bipolar rather than monopolar heads (57.9%-79.5%).

CONCLUSION: Orthopedic oncologists do not agree on reconstructing metastatic defects with THA vs. hemiarthroplasty for patients with younger age, bone only disease, and favorable histology. This investigation indicates the need for a prospective study to evaluate patient outcomes following reconstruction of metastatic defects of the femoral head and neck in order to determine the optimal treatment method for these patients.

Long-Term Outcomes and Satisfaction of Rotationplasty Patients in the Treatment of Lower Extremity Sarcomas with Cost Analysis of Rotationplasty and Expandable Megaprosthesis

Abstract ID: Paper 054

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BACKGROUND: There are many options for restoring function in the treatment of lower extremity sarcomas in younger children. Sacrifice of the physis in a child four or more years from skeletal maturity presents distinct challenges. Currently, the trend is toward the use of expandable megaprosthesis in the skeletally immature patient. However, leg-length discrepancy and durability of expandable endoprostheses may require reconsideration of reconstructive options. We looked to explore long-term functional results and satisfaction of a rotationplasty cohort. We also analyzed the estimated lifetime cost of rotationplasty versus expandable megaprosthesis.

QUESTIONS/PURPOSES: The purpose of our study was to obtain and analyze long-term functional, emotional, and physical outcomes of skeletally immature patients who underwent rotationplasty at our institution. We analyzed the cost of rotationplasty and expandable megaprosthesis. We hypothesize that rotationplasty patients will be satisfied with their outcome and rotationplasty is a cost-conscious option.

PATIENTS AND METHODS: This institution performed 24 rotationplasties from 1991-2004. A survey was sent to the surviving members of the cohort. A survey queried the participants for emotional and physical impact of rotationplasty using multiple validated tests. We obtained the hospital bills of patients who underwent rotationplasty and expandable megaprosthesis placement. We compared these values and extrapolated these two surgical options over a patient's expected lifetime.

RESULTS: Of the 24 rotationplasty patients, at least 7 died of disease. Two were ineligible. Seven patients were lost to follow-up. Results were based on the remaining eight. The average age of rotationplasty was 11.6 years old. The average age at time of follow-up questionnaires is 30.0 years old. The average follow-up time is 18.4 years from rotationplasty. The average MSTS score was 68.33%. The average TESS score was 90.025%. The SF-36 results in norm-based scoring (N) were summary of physical health (PC) 46.4 and summary of mental health (MC) 55.6. We found that the average lifetime cost of rotationplasty is $324,748.44 and for expandable megaprosthesis placement is $440,032.26.

CONCLUSIONS: In our study, the patients who are alive without disease are functioning well at greater than 18-year follow-up. Based upon the SF-36 scores, our rotationplasty cohort functions comparably with the general population on all levels. Rotationplasty is also the more cost-effective option. Based upon our findings, we believe that rotationplasty should be a valid and possibly superior option in certain cases in limb salvage surgery.

Changes in Diagnosis and Management in Tumor Patients Participating in Multidisciplinary Tumor Board

Abstract ID: Paper 055

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BACKGROUND: Multidisciplinary tumor boards are an integral part of most cancer centers. Though these interdisciplinary environments are generally thought to be beneficial, not much has been done to quantify their usefulness.

QUESTIONS/PURPOSES:
1. We wanted to quantify how often participation in our center's multidisciplinary tumor board led to changes of interpretation and/or management in our patient's care.
2. We wanted to categorize these changes into broad areas divided broadly between interpretation and management.

PATIENTS AND METHODS: Using our form developed for mobile devices, we prospectively (real-time) collected de-identified data regarding changes made during our multidisciplinary tumor board from February to August 2015 (n = 108 patients). The results were imported into a spreadsheet and categorized into 6 main areas (i.e., changes in management based on review of radiology, total number of changes in radiographic interpretation, changes in pathologic interpretation, changes in management based on review of pathology, total changes in management made, and total number of changes). Our spreadsheet data was then analyzed in conglomerate to get an average change per patient for our sample.

RESULTS: No IRB was deemed necessary in the collection of this data. We found that changes could be categorized into 6 main categories as summarized above. There were 128 total changes in 108 patients or an average of 1.2 changes per patient. 27.8% of patients had a change in their radiographic interpretation, while 83.3% had changes in their management. Changes in management represented the largest category with 90 changes noted in 108 patients. The minimum change per patient was 0 and the maximum was 4.

CONCLUSION: Multidisciplinary tumor boards effect the majority of patients reviewed in the form of changes in both interpretation and management. Multidisciplinary tumor boards seem to offer a high yield collaborative environment that affect our patient's diagnosis and treatment.

Long-Term Outcome Following Limb Salvage with the Use of Massive Bone Allograft In Pediatric Patients: Supplementation with a Free Fibula is Superior to Allograft Alone for Limb Salvage

Abstract ID: Paper 056

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INTRODUCTION: Reconstruction following limb salvage surgery can be complicated by large segmental bony defects. Although structural allografts have been traditionally used to reconstruct these defects, there is a paucity of information examining their use specifically in pediatric patients. The purpose of this study was to examine the long-term outcome using bulk structural allografts for limb salvage in pediatric patients, specifically focusing on (1) allograft union, (2) overall and disease specific survival, (3) rates of allograft revision and limb-salvage, and (4) patient outcome.

MATERIAL AND METHODS: Over a 30-year period, we identified 54 pediatric (26 male and 28 female) patients who underwent limb salvage with the use of massive cadaveric allograft at a mean age of 13 years and the mean follow-up was 15 years. The most common diagnosis was osteosarcoma (n=42). Twenty-five (46%) patients were reconstructed with a free-fibula, either in an on-lay (n=7) or intramedullary Capanna technique (n=16). MSTS rating scale and Mankin scores were recorded for surviving patients.

RESULTS: The mean time to union of the allograft and fibula to the native bone was 15 months. The overall rate union was 96%; with 13 patients needing to undergo a revision procedure for repeat bone grafting. The 10-year disease-free and overall survival was 80% and 75%. Patients with 90% tumor necrosis at the time of resection had improved survival (HR 0.16, P =0.01). 11 patients underwent an amputation for an overall limb-salvage rate of 80%. The allograft was revised in 12 patients. Patients where the allograft was supplemented with a vascularized bone transfer were at significantly reduced risk of revision (P<0.0001). There were no cases of allograft revision for patients who underwent the Capanna technique, with these patients having significantly improved 10-year allograft survival compared to patients reconstructed with any another technique (100% vs. 71%, P=0.02).

At last follow-up the mean MSTS rating was 82%. There were 36 (67%) patients who achieved a “good” or “excellent” outcome with 17 (31%) “failures” according to the Mankin score.

CONCLUSION: The use of cadaveric allografts is a reliable option for the reconstruction of bony tumors in the pediatric population. Following the procedure, a majority of patients achieve a good functional result with a high rate of disease-free survival. The results of this study suggest that supplementation of the allograft with a vascularized bone graft, notably the Capanna technique, improved the ability to achieve limb salvage.

Orthopaedic In-Training Exam: A Performance Review Based on Program and Resident Specific Factors

Abstract ID: Paper 057

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INTRODUCTION: The Orthopaedic In-Training Examination (OITE) is the most common and objective method used to assess resident knowledge in the U.S. As such, residents and programs utilize a number of strategies to maximize OITE performance. The purpose of this work was to better understand what strategies were being implemented and to determine which program specific and resident specific characteristics best correlate with improved scores.

METHODS: A national survey of orthopedic residents and program directors (PDs) was conducted. All participants were asked about past OITE performance and the frequency with which they (or their program) utilize various test preparation strategies. The efficacy of these strategies was assessed by comparing the mean OITE scores between those who utilize each technique to those who do not.

RESULTS: The survey was completed by 33 of 48 (68.8%) PDs who represented 777 residents for the comparison of program specific characteristics. A total of 341 of 878 (38.8%) eligible residents completed the survey and were used for the analysis of resident specific characteristics. The most commonly utilized program wide strategies were: negative consequences for poor performance (72.7%), formal OITE prep program (54.5%), and purchase of OITE test prep material for residents (51.5%). The program specific characteristics that had the strongest correlation with increased scores were negative consequences for poor performance ($p<0.001$), high value placed on the OITE by PD and residents ($p<0.001$), excusing residents from clinical duties the evening prior ($p<0.001$), having residents take the exam on different days ($p=0.012$), and allowing residents to lead a review course ($p=0.047$). The resident specific characteristics that best correlated with score were increased study time leading up to the test ($p=0.031$) and attendance at their programs OITE prep program (0.062).

DISCUSSION AND CONCLUSIONS: Although programs and residents looking to improve knowledge acquisition and OITE scores use a number of techniques, a few distinct strategies correlate with the greatest increases in OITE performance. These may be appropriate methods to consider for programs and residents looking to improve their test performance and knowledge acquisition.

Protected Time for Research During Orthopedic Residency Correlates with an Increased Number of Resident Publications

Abstract ID: Paper 058

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INTRODUCTION: The ACGME requires orthopedic residency programs to promote scholarship with an active research component, which manifests differently among programs. Common factors thought to influence research productivity are research curricula, funding, mentorship, and protected resident time. We assess the impact of protected research time during orthopedic residency on the number of resident publications and hypothesize that increased protected time will positively correlate with publication rates.

METHODS: Rotation schedules and resident names were collected from the 157 accredited orthopedic residency programs' websites. Dedicated research time was classified as (1) block time [>3 consecutive weeks free from clinical duties], (2) longitudinal time [>2 days per month for >6 months], or (3) none. 6-year programs and new programs without full classes were excluded, as were programs without a rotation schedule or list of current resident on the website. Residents who had spent research time at their institution outside of residency were also excluded.

PGY 3 through 5 residents were searched on pubmed.com during a one-month period to generate all publications with a PubMed identifier (PMID). All orthopedic publications were included if published after January of the resident's PGY1 year, published through the resident's home institution, and included at least one other author from that institution.

The number of PMIDs for each program were summed and divided by the total number of PGY 3-5 residents, giving a mean number of publications per resident. The relationship between output and type of research time was compared using t-tests and ANOVA.

RESULTS: Of the 109 programs that met inclusion criteria, 78 offered block time, 13 offered longitudinal time, and 18 offered no dedicated research time. 1,532 residents met inclusion criteria, with 1.37 (range: 0 to 32) as the mean number of publications. Block time resulted in a mean of 1.05 (range, 0 to 6.0) publications per resident; longitudinal time, 1.85 (range 0 to 6.14); and no time, 0.55 (range, 0 to 1.22). A statistically significant difference in output ($p=0.02$) was noted between residents with research time (mean 1.17 ± 1.13) and those without (mean 0.55 ± 0.40).

One-way ANOVA demonstrated a difference across all 3 groups ($p=0.003$), with longitudinal research rotations correlating to significantly more publications using Bonferroni post-hoc analysis.

DISCUSSION: Both presence of and type of dedicated research time correlate with research productivity. As fellowship applications become more competitive and orthopedic programs look to promote interest in research, further consideration of protected research time during residency is warranted.

Non-Anatomic Virtual Arthroscopy Simulator Effective in Developing Arthroscopy Motor Skills

Abstract ID: Paper 059

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PURPOSE: The purpose of this study was to determine the effectiveness of a commercial, nonanatomical virtual reality arthroscopy training simulator (VIrtaMed ArthroS FAST module) in developing motor skills in arthroscopy naïve individuals.

METHODS: Medical students at a tertiary academic center were recruited via email and randomized to an experimental group (16 students) or a control group (13 students). All subjects performed a diagnostic knee arthroscopy initially and at a time between one and two weeks later. Subjects in the experimental group performed a series of five self-guided modules in the non-anatomical FAST model prior to performing their second diagnostic knee scope. Composite score, cartilage damage, time, and camera path length between the two groups was compared.

RESULTS: There were 17 males and 12 females included in this study with an average age of 25.6 years (range, 21-33). The group completing the self-guided modules on the non-anatomic simulator demonstrated superior performance in all outcome measures including composite score (27.8 vs. 22.5), camera path length (73.9 vs. 106.7 cm), tibia cartilage damage (2.7 vs. 3.3%), femur cartilage damage (4.4 vs. 4.8%), and time (167.3 vs. 225.4 seconds), $p>0.05$ for all. Average time to complete the five modules was 75 minutes. Skill improvement was greater in each category when comparing the pre and post-test between groups as well: composite (16.3 vs. 9.0, $p= 0.05$), time (-163.4 vs. -152.2 seconds), femur cartilage damage (-2 vs. -1.2%), tibia cartilage damage (-1.9 vs. -1.6%), and camera path length (-90.85 vs. -79.0 cm). All students rated the arthroscopy simulator as “desirable” or “highly desirable” for an orthopedic elective. A the time of the second knee scope, 12/29 (41%) reported the simulator experience had a minor or strong positive impact on their consideration of a career in orthopedics.

CONCLUSION: Non-anatomic virtual reality arthroscopy simulators are beneficial in developing basic motor skills in arthroscopy naïve individuals resulting in improved time, safety, and overall performance.

Sleeping Well on Call: Differences in Sleep Patterns Among Orthopedic Surgery Residents by Training Level and Call Type

Abstract ID: Paper 060

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Duty hour restrictions have changed residency training through the implementation of various techniques as a means to meet (ACGME) requirements. Surgical specialties, not withstanding orthopedics, have undertaken such changes with limited evidence. The purpose of this study was to objectively determine sleep time differences between (1) call type (home vs. in-house) and (2) training level (senior vs. junior) utilizing FitBit™ activity monitors and subjective measures to record sleep. Furthermore, we determined the most important factors that impacted sleep while on call. Participants in the study were PGY2-PGY5 orthopedic surgery residents. 19 eligible participants were split into junior (PGY2 and PGY3) and senior resident (PGY4 and PGY5) cohorts. The primary outcome was sleep time. Residents recorded how many consults or phone calls received, hours in the hospital, if they operated, time operated, and the sleep achieved subjectively. Junior and senior residents on home call slept an average of 172.25 and 49.89 minutes ($p<.001$) more, respectively, than the in-house cohort. Senior residents slept an average of 248.46 and 126.1 minutes more than the on home and in-house call junior cohorts, respectively ($p<.001$). The most important negative predictor of sleep in both measures in the junior resident cohort was the number of consults received ($p<.001$). Being on in-house call was a negative predictor of sleep in juniors only on Fitbit™ measures ($p<.05$); similarly, the month on call was a negative predictor in juniors only on subjective sleep measures ($p<.05$). The most important negative predictor on both measures of sleep for senior residents was whether or not they had to operate ($p<.001$). Home call provided both senior and junior residents more sleep on call. However, total time slept on call is only one metric of overall sleep quality.

Patient Loss to Follow-Up After Upper Extremity Surgery: A Review of 2,636 Cases

Abstract ID: Paper 061

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INTRODUCTION: Post-surgical follow-up is a vital part of patient care. The purpose of this study is twofold; first, to determine the incidence of postoperative patient loss to follow-up following hand and upper extremity surgery, and second to identify factors that can help to identify patients at elevated risk of loss to follow-up. We hypothesize that there will be a correlation with loss to follow-up and demographic patient variables in a surgical hand and upper extremity practice.

METHODS: 2,834 surgical cases (2,467 patients) were retrospectively reviewed. Inclusion criteria were: surgery staffed by an attending of the sponsoring institution, all procedures including elective and non-elective. Exclusion criteria were patients: who are prisoners, scheduled to follow-up at outside institutions, still in follow-up, who underwent bedside procedures, died before follow-up was complete, have Veterans Association insurance, or unknown insurance status at the time of billed procedure. Charts were reviewed for compliance with postoperative follow-up. Demographic variables including insurance type, length of follow-up period, age, and gender were analyzed to determine correlation with follow-up. Variables were described with proportions and compared using logistic regression analysis. Odds ratios and confidence intervals were calculated with a p-value ≤ 0.05 signifying statistical significance.

DATA AND RESULTS: 2,834 surgical cases (2,467 patients) were identified in the study period. 2,636 cases (2,277 patients) met inclusion and exclusion criteria. Overall loss to follow-up rate was 29%. Patients lost to follow-up based on insurance type were 19% for Worker's Compensation, 23% for Medicare, 24% for private insurance, 41% for Medicaid, and 49% for self-pay. All of these groups were significantly different ($p<0.05$) when compared to privately insured patients when adjusted to the other variables, except worker's compensation ($p=0.10$). Patients with expected short-term follow-up were lost at a 27% rate. When compared to short-term follow-up, expected mid-term and long-term follow-up patients were lost at 36% and 21% rates, respectively ($p=0.005$, $p=0.019$). Patients under 30 years of age were lost to follow-up at a 44% rate when compared to patients 30-64 years old (28%, $p<0.0001$) and 65 and older (16%, $p<0.0001$). Males had a higher rate of loss to follow-up, 35% compared to females (24%, $p<0.0001$).

DISCUSSION: Multiple demographic variables may identify high risk patients, which could allow surgeons to proactively educate them on the importance of follow-up. This could improve patient care and outcomes. Risk factors included: self pay, Medicaid, and Medicare insurance, younger age, mid-term follow-up period, and male gender.

Surgeon Experience and Academic Productivity's Effects on Industry Payments

Abstract ID: Paper 062

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INTRODUCTION: The Sunshine Act was passed to increase financial transparency between physicians and manufacturers. To better understand what factors influence money received, we analyzed how years in practice and academic standing, assessed via number of orthopedic publications, influence number of payments and total sum received.

METHODS: A web collection algorithm was developed that collected data from August 2013 to December 2014 in ProPublica.com's Dollars for Doctors database. The names of 26,024 active U.S. orthopedic surgeons were obtained from a separate dataset. Data collected included number of payments, value of each payment, and total lump sum received in the above time period. Lastly, a separate algorithm was developed that searched surgeons' names on the NCBI PubMed website, and lists of each surgeon's publications are cross-referenced to determine number of publications in the 50 orthopedic journals with the highest impact factor. Multiple regression was used to assess influence of orthopedic-specific publications and years of experience on both number of payments, and total received.

RESULTS: Of the 26,024 surgeons analyzed, 18,126 (70%) had received at least one industry payment between August 2013 and December 2014. Of surgeons receiving at least one payment, mean payment total was $26,073±28,7141.3. Payment distribution was not normally distributed with skewness of 46 and kurtosis of 3115. The top 5th percentile of earners totaled 88% of money made by all orthopedic surgeons. When comparing the total value amount of payments received to the number of publications per physician, we found a positive linear relationship. For each additional publication, there was a $2,057.26 increase in industry payments received per surgeon ($p<0.001$). Comparing those who received at least one payment vs. those who did not, the mean number of publications differed (9.1±25.6 vs. 6.8±17.5, $p = 0.03$). Between those who received payments and those who did not, mean number of years experience differed as well (25.98±10.00 vs. 34.2±11.72, $p < 0.0001$). Lastly, we found an inverse relationship between the number of years in practice of a surgeon and the total number of payments received. For each additional year in practice, there was a 0.45 decrease in total number of payments received ($p<0.001$).

DISCUSSION: Thought leaders in the orthopedic community received a larger number of industry payments and a larger total value amount of payments. Younger surgeons received higher payment totals and number of payments. Additionally, a minority of orthopedic surgeons account for a large percentage of money received.

Physician Rating Scales Do Not Accurately Rate Physicians: A Systematic Review for Orthopedic Surgeons

Abstract ID: Paper 063

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INTRODUCTION: Physician rating systems are becoming widely utilized. Many surgeons argue that the multifaceted nature of these questionnaires includes factors outside of the physician's control. The purpose of this investigation was to perform a systematic review to determine (i) the components of care evaluated by currently available online physician grading scales, and (ii) which of these factors are under the direct control of or directly grade the physician. The study hypothesis was that less than 50% of the factors used to rate physicians are under their direct control and/or directly grade them.

MATERIALS AND METHODS: A systematic review was performed to identify online, patient-reported, physician rating scales. Data extracted from these scales included: (1) website demographics/characteristics, (2) components of the physician grading scale relevant to the physician, and (3) components of the physician grading scale not relevant to the physician. Descriptive statistics were calculated.

RESULTS: Fourteen websites were identified containing patient-reported physician rating scales. There was a mean 11 (SD 16, Range 1-62) checkbox questions and 1 (SD 1, Range 0-2) comment box. Overall, 31% of questions directly rated the physician, 47% rated both the physician and office, and 21% rated the office alone. The most common questions used were versions of: (1) "courtesy/helpfulness of office staff" (79%), (2) "overall rating" (57%), (3) wait times/promptness/punctuality (57%), (4) "trust/confidence in physicians' knowledge & decisions" (50%), (5) "time spent with patient" (43%), (6) "listens to and answers questions" (43%), and (7) "recommend to family/friend" (43%). While 2 questionnaires (14%) included a patient-reported "treatment success" question, none (0%) included patient-reported "surgeon skill" questions or reported any outcome scores to measure success.

CONCLUSIONS: Orthopedic surgery is the second most searched specialty on physician rating websites. Only 4 of the 14 rating scales reviewed had the highest proportion of questions grading the physician directly. The other 10 systems focused their questions on either: the physician and the office together or the office alone. Overall, the proportion of questions directly grading the physician was well below our hypothesis at 31%. Prior studies have mentioned that physician ratings are often determined by the office staff and décor, rather than the quality of care received. It is vital that physicians understand these systems and help to shape them into something more pertinent by incorporating questions focused on the physician themselves and reporting objective outcome scores. This will allow patients to make more educated choices about their care.

Physician Rating Websites: Can Surgeons Influence Their Outcomes?

Abstract ID: Paper 064

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INTRODUCTION: Patient use of physician rating websites (PRWs) is becoming an increasingly popular as a means to evaluate surgeons, yet few surgeons choose to claim or update them. There is also a dearth of evidence-based advice on the utilization and management of PRWs. This study was designed to evaluate three techniques for facilitating patient-generated physician evaluations us-ing two commonly used PRWs, Healthgrades.com, and Vitals.com.

METHODS: Eight hand surgeons participated. Their online profiles were claimed for Healthgrades.com and vitals.com, and each surgeon was given printed cards containing direct links to their online profiles. Three surgeons actively distributed the cards to selected patients. Five surgeons distributed cards passively to all patients via their medical assistant. Cards containing a link to Healthgrades.com were used for 4 weeks, followed by those with a link to Vitals.com for 4 weeks. Lastly, a third arm arm targeted three month postoperative patients via direct links contained in automated e-mails.

Rating scores and the number of both ratings and written reviews were recorded before and two weeks after card distribution, and then before and two weeks after the electronic distribution of evaluation links. We recorded the number of cards distributed along with electronic requests sent and opened.

Variables analyzed included change in overall score, ratings and reviews added, and the response rate to passive, active, and electronic distribution techniques. Statistical analysis was performed using paired T-tests, with statistical significance set at $p<0.05$.

RESULTS: Historic evaluation rates were 0.25 ratings/month and 0.05 written reviews/month per surgeon. After 4 weeks of distributing cards, rates increased to 36 ratings/month and 26 reviews/month in the active group, and 9.7 ratings/month and 7.1 reviews/month in the passive group. Active and passive distribution resulted in Healthgrades.com response rates of 27% and 7%, and Vitals.com response rates of 30% and 8%, respectively. Electronic requests sent via automated email yielded a 30.9% response rate.

DISCUSSION AND CONCLUSIONS:
1. Surgeons can effectively influence their PRW ratings.
2. All techniques achieved response rates substantially higher than historic practice rates, with the highest observed via direct active requests or emails.
3. There was no qualitative difference in review scores using any technique.
4. Surgeons with low starting scores improved most.
5. Limitations include a small group of surgeons, sub-specialized practice, and a single institution of study.

MAOA SECOND PLENARY SESSION
April 21, 2017

What Does Conservative Management of Knee Osteoarthritis Cost During the Year Prior to TKA?

Abstract ID: Paper 065

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INTRODUCTION: The American Academy of Orthopaedic Surgeons (AAOS) has recently released their clinical practice guidelines (CPG) for Treatment of Osteoarthritis of the Knee, Second Edition. This guideline utilizes the best available literature to guide recommendations regarding non-arthroplasty management of knee osteoarthritis (OA). However, despite guidance from this CPG, or the previous edition, many of the non-recommended treatments remain in common use. We sought to determine cost associated with non-arthroplasty management of knee OA in the year prior to total knee arthroplasty (TKA) and stratify them by CPG recommendation status.

METHODS: The Humana Inc. database was reviewed from 2007-2015 for patients undergoing primary TKA. This represents over 20 million lives. Cost of hyaluronic acid (HA) and corticosteroid (CS) injections, physical therapy (PT), braces, wedge insoles, opioids, non-steroidal anti-inflammatories (NSAID), and tramadol in the year prior to TKA were calculated. Treatments were only included if specifically associated with a diagnosis of knee OA. Treatments, knee OA diagnosis, and TKA procedures were identified by ICD-9 and CPT-codes. Costs were analyzed relative to non-inpatient cost of knee OA and CPG recommendations.

RESULTS: In total, 86,073 primary TKA patients were included. In the year prior to TKA, total cost associated with knee OA was $78,392,953 and non-inpatient cost associated with knee OA was $43,582,648. Of the total patients, 56,690 patients (65.8%) underwent at least one of the analyzed treatments in the year prior to their TKA. The three most costly treatments were HA injections, CS injections, and PT. In aggregate, all treatments made up 57.6% of the total non-inpatient cost of knee OA. Only three treatments studied are recommended by the CPG (PT, NSAIDS, tramadol) and cost for these interventions represent 11.1% of non-inpatient knee OA costs. In contrast, cost associated with interventions not recommend by the CPG with strong or moderate evidence against their use is 29.3% of non-inpatient knee OA costs.

CONCLUSIONS: Over half of the non-inpatient costs associated with knee OA during the year prior to TKA are from injections, therapy, prosthetics, and prescriptions. Approximately 30% of

this cost is due to HA injections alone, for which the CPGs cite strong evidence against their use. If only interventions recommend by AAOS in their CPG are utilized, then cost associated with outpatient management of knee OA could be decreased by 90%. Future research is needed to evaluate the impact of the CPG on unnecessary costs as further time elapses from their publication.

CAM Morphology and Limited Hip Range of Motion is Associated with Early Osteoarthritic Changes in Adolescent Athletes: A Prospective Matched Cohort Study

Abstract ID: Paper 066

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INTRODUCTION: The purpose of this investigation was to evaluate changes in MRI, radiographs, and clinical examination over 5 years in a group of athletes with asymptomatic limited range of motion (LROM) of the hip compared to matched controls.

METHODS: We screened 226 athletes age 13-18 presenting for pre-participation sports physicals. Hip internal rotation was assessed with the hip flexed to 90°; 13 patients were identified with internal rotation <10°. These patients were age- and sex-matched to 13 controls with internal rotation >10°. At the time of enrollment, all patients were asymptomatic and received a complete hip examination and radiographic imaging. Patients returned at 5-year follow-up and completed repeat hip examination, hip radiographs, hip MRI, as well as the hip disability and osteoarthritis outcome score (HOOS). All 26 patients (52 hips) had complete evaluation at the time of enrollment; to date 21 patients have been seen at 5-year follow-up; however, five patients are scheduled for evaluation in the next month for eventual 100% follow-up.

RESULTS: Upon enrollment, 16/26 hips (62%) in the LROM group had abnormal MRI findings within the acetabular labrum or cartilage compared with 8/26 hips (31%) in the control group (RR=2.0; 95% CI=0.95-4.2; P=0.068). At 5-year follow-up, 16/17 hips (94.1%) in the LROM group had abnormal MRI findings compared with 12/24 hips (50%) in the control group (RR=1.9; 95% CI=1.2-3.0; P=0.013). New or progressive findings were documented on MRI in 13/18 hips in the LROM group compared to 6/24 hips in the control group (RR=2.9; 95% CI=1.4-6.2; P=0.007). Mean HOOS score was lower in the LROM group at 5-year follow-up: 94.1 (range 86.3-100) vs. 99.5 (range 97.5-100) (p<0.001). Positive anterior impingement sign was associated with progressive MRI findings (RR=2.2; 95% CI=1.3-3.6; P = 0.005). Mean HOOS score was lower for those with a CAM lesion than without (mean=95.9 vs. 99.1; P=0.03).

CONCLUSIONS: At 5 years, young athletes with LROM of the hip show increased progressive degenerative changes compared to matched controls. Patients with positive anterior impingement signs and CAM lesions at the time of enrollment showed increased risk of new or progressive MRI abnormalities or lower functional scores. Although the majority of these patients remain asymptomatic, those with LROM seem to be on an accelerated path toward development of osteoarthritis. These findings suggest that more aggressive screening and

counseling of young active patients may be helpful to prevent hip osteoarthritis in those with LROM or FAI.

The Effect of Local Steroid Application vs. Intravenous Steroids on Dysphagia and Dysphonia Following Anterior Cervical Discectomy and Fusion (ACDF): A Single-Blind, Prospective, Randomized Control Trial

Abstract ID: Paper 067

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INTRODUCTION: Dysphagia and dysphonia are the most common complications following anterior cervical discectomy and fusion (ACDF). Previous studies have demonstrated that IV and local steroids can decrease prevertebral soft-tissue swelling and postoperative dysphagia. However, no standardized studies have compared the efficacy of local steroid application to intravenous (IV) steroid administration during ACDF on postoperative dysphagia and dysphonia. A prospective randomized clinical trial was performed using validated patient outcome measures to assess the efficacy of intraoperative steroid administration on dysphagia and dysphonia after ACDF. In addition, the study evaluated if route of steroid administration (IV vs. local) yields different outcomes in regards to dysphagia and dysphonia.

METHODS: 72 patients undergoing ACDF for the treatment of cervical degenerative disease were recruited. Exclusion criteria included: age under 18 years, operations for trauma/infection/tumor/revision, or general metabolic diseases (diabetes, heart disease). Patients were randomized into three cohorts: control (no steroid), IV steroid (intraoperative IV decadron), or local steroid groups (40 mg of triamcinolone on gel foam sponge placed on cervical plate). Subjects were blinded from which treatment arm they received. Primary outcome measures where the incidence of abnormal patient reported outcomes for dysphagia (Bazaz, Eat-10) and dysphonia (VHI-10). Secondary outcomes include Neck Disability Index (NDI) and Visual Analog Scale (VAS) for neck pain. Patient outcomes were collected preoperatively, postoperative day 1, week 2, and week 6. Statistical analysis was completed with significance set at $p < 0.05$.

RESULTS: Baseline patient reported outcomes in each cohort were not significantly different. Day 1 postoperative patient outcomes scores showed a significant improvement in VHI-10 ($p=0.026$), VAS neck pain ($p=0.025$), and a trend towards significance in Bazaz classification ($p=0.057$) with significance driven by the improved outcomes in the local steroid cohort. Two weeks postoperative patient outcome scores showed a significant improvement in Bazaz classification ($p=0.026$), Eat-10 score ($p=0.011$), and VAS neck pain in the local steroid cohort. Bazaz classification ($p=0.001$) and Eat-10 score ($p<0.001$) showed significant improvement at 6 weeks postoperative in the steroid cohorts.

CONCLUSION: Local steroid application at the conclusion of cervical plating in ACDF surgery yields better patient-reported outcomes for dysphagia, dysphonia, and neck pain, when compared to no steroid or IV steroid administration.

Intravenous Tranexamic Acid Reduces Blood Loss in Reverse Total Shoulder Arthroplasty: A Prospective, Double-Blinded, Randomized, Controlled Trial

Abstract ID: Paper 068

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BACKGROUND: Patients undergoing a reverse total shoulder arthroplasty (RTSA) are at risk of significant perioperative blood loss. Tranexamic acid (TXA) is a synthetic antifibrinolytic agent that has been successfully used intravenously to significantly reduce perioperative blood loss, blood transfusions, and associated costs in major cardiac, vascular, obstetric, and orthopaedic procedures. To date, few studies have examined the effectiveness of TXA to reduce blood loss in the setting of RTSA.

METHODS: In a prospective, double-blinded trial we analyzed 102 patients undergoing primary RTSA by a single surgeon that were randomized to receive intravenous TXA or placebo. The primary objective was to determine whether TXA significantly reduces total blood loss as measured by calculated blood loss, drain output, and drop in hemoglobin (Hb). Postoperative Hb and drain output was recorded at 24 and 48 hours. Additionally, postoperative transfusions were recorded for each patient. All in-hospital complications were recorded and patients were assessed at 3 weeks and 6 weeks following surgery for any adverse events.

RESULTS: Total blood loss was significantly less for the TXA group (1122.4 mL ± 411.6) than for the placebo group (1472.6 mL ± 475.4, $P<0.001$). Total drain output also varied significantly between groups with 371.9 mL ± 166.3 for the placebo group and 221.4 mL ± 126.2 for the TXA group ($P<0.001$). The total Hb loss after surgery was significantly reduced in the TXA group (154.57 g ± 60.29) as compared to the placebo group (200.1 g ± 65.5, $P=0.001$). Transfusion rates varied significantly postoperative day 1; however, overall transfusion rates did not vary significantly. Seven patients (14.3%) and 12 units were transfused in the placebo group compared to three patients (5.7%) and 3 units in the TXA group.

CONCLUSIONS: In this cohort of patients undergoing a primary RTSA, TXA was effective in reducing drain output at 24 hours, total drain output, total Hb loss, total blood loss, and minimum recorded Hb compared to a placebo control.

MAOA BREAKOUT SESSION #6
FOOT AND ANKLE
April 21, 2017

Does Hospital Size and Teaching Status Impact Patient Outcomes Following Total Ankle Arthroplasty?

Abstract ID: Paper 069

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INTRODUCTION: The popularity and utilization of total ankle arthroplasty (TAA) as treatment for end-stage ankle arthritis has increased 7 fold from 1998 to 2010. Although outcomes for TAA have improved with new-generation implants, there are still relatively high rates of complication and failures. To date, limited data exist examining the effects of hospital characteristics on outcomes for TAA.

METHODS: The Nationwide Inpatient Sample (NIS) database was queried from 2002-2012 using the ICD-9 procedure code 81.56 for TAA. The primary outcomes evaluated included: in-hospital mortality, length of stay, total hospital charges, discharge disposition, perioperative complications, and patient demographics. Analyses were carried out based on hospital size: small, medium, and large; and hospital setting and teaching status: rural non-teaching, urban non-teaching, and urban teaching.

RESULTS: A total weighted national estimate of 16,621 discharges for patients undergoing TAA was reported over the 10-year period. There were significant differences ($P < 0.005$) in length of stay and total charges between all hospitals when comparing location and teaching status; however, no significant differences were noted for in-hospital mortality. Rural, non-teaching hospitals had the lowest charges ($46,187.91) but the longest length of stay (2.74 days); urban non-teaching hospitals had the shortest length of stay (2.41 days) but highest charges ($68,580.88). Rural hospitals had elevated rates of non-routine discharge (odds ratio [OR] 1.30; 95% CI [1.10-1.50]), but the highest rate of non-routine discharges was at urban non-teaching hospitals (OR 1.43; [1.40-1.54]).

There were also significant differences in length of stay and total charges when comparing hospital sizes. Large hospitals had the longest length of stay (2.55 days) and highest charges ($61,811.34) compared to small and medium-size hospitals. In-hospital mortality was not significantly different between hospital sizes, but non-routine discharge was significantly higher at small hospitals (OR 1.13; [1.03-1.30]). Rural hospitals demonstrated significantly elevated complication rates of ileus, cerebrovascular accidents, and blood transfusions; smaller hospitals demonstrated increased risks for deep vein thrombosis and urinary tract infections.

CONCLUSIONS: Overall, patients can feel assured that there is no increased risk of mortality after TAA regardless of hospital size or setting. While it appeared that larger hospitals had higher charges and increased resource utilization, smaller hospitals tended to rely on increased non-routine discharges, which may contribute to these differences. Our analyses demonstrate a complex relationship between cost and resource utilization for TAA, and clearly additional work is needed to optimize this relationship, especially in the upcoming bundled payment models.

Assessing Lateral Ankle Instability Following Modified Broström Procedure

Abstract ID: Paper 070

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BACKGROUND: There are multiple techniques to reconstruct the lateral ankle ligamentous supports, all of which can be grouped into two distinct classifications: anatomic repairs and non-anatomic reconstruction. The Gould modification of the Brostrom procedure focuses on late repair of the anterior talofibular and calcaneofibular ligaments anatomically while supplementing these repairs with the inferior retinaculum of the ankle. The procedure focuses on elevating the torn ligaments from the fibula to re-establish the normal restrain by imbricating the lateral ligaments. The clinical success of the modified Brostrom has made it one of the most common procedures for the treatment of chronic lateral ankle instability. The modified Brostrom repairs the static lateral ligamentous stabilizers of the ankle; however, in patients with a gastrocnemius contracture, the narrower posterior talar dome is held within the mortise. This decreased bony contact reduces stability and may be perceived by patients as continued instability postoperatively. We hypothesize that by performing a gastrocnemius recession in conjunction with a modified Brostrom, the degree of stability will be increased.

METHODS: This is a retrospective chart review of patient data collected from 600 patient charts from both Spectrum Health and Metro Health, as well as Orthopedic Associates of Michigan (OAM). Patient recruitment will be from these records. The medical students conducted the chart review. The timeframe for study completion is 12 months, including manuscript preparation. The senior authors have previously served as investigators on research projects at Spectrum Health. The principal investigators are board certified orthopedic surgeons with foot and ankle fellowship training and extensive experience in research.

RESULTS: Average preoperative AOFAS pain score was 20.33 for patients receiving an isolated modified Brostrom and 17.07 for those receiving a concomitant gastrocnemius recession. Average postoperative pain score was 32.29 for patients receiving an isolated modified Brostrom and 32.44 in those receiving a concomitant gastrocnemius recession. Preoperative AOFAS stability was present for 9.8% of patients receiving an isolated modified Brostrom and 13.4% for patients receiving a concomitant gastrocnemius recession. Preoperative stability was present in 76.8% in patients receiving an isolated modified Brostrom and 86.6% of those receiving a concomitant gastrocnemius.

CONCLUSIONS: Gastrocnemius recession with a modified Brostrom had increased pain

preoperatively but equivalent pain postoperatively. There was a clinically significant difference comparing postoperative stability in patients who received a gastrocnemius recession.

Minimum 20-Year Follow-Up of Semiconstrained Total Ankle Arthroplasty: Benchmark for Future Designs

Abstract ID: Paper 071

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INTRODUCTION: With the introduction of newer generations of total ankle arthroplasty (TAA) constructs, the incidence of TAA in the United States has been increasing. While TAA has emerged as an alternative to ankle arthrodesis for the management of end-stage ankle arthritis, long-term data evaluating clinical outcomes and the survivorship of ankle prostheses is lacking. The purpose of this study was to report the clinical outcomes and radiographic survivorship of a second-generation, semi-constrained titanium and cobalt-chromium total ankle prosthesis at minimum 20-year follow-up in order to provide a benchmark comparison for future generations of TAA design.

METHODS: 132 total ankle replacements in 126 patients were performed by a single surgeon between July 1984 and October 1994. Follow-up evaluation consisted of determining revision status, completion of the validated ankle osteoarthritis scale, a short questionnaire, and a review of the available radiographs. All radiographs were evaluated for evidence of progressive radiolucent lines, osteolysis and component subsidence.

RESULTS: At minimum 20-year follow-up, 37 patients were alive, 89 were deceased, and 5 were lost to follow-up. For living patients, average clinical follow-up was 25.3 years. Average radiographic follow-up was 21.4 years. Over the minimum 20-year follow-up, 29 ankles were revised (23%). For living patients, 13 ankles were revised (35%).

CONCLUSION: Twenty-three percent of all patients and 35% of living patients required a revision over the minimum 20-year follow-up interval. 65% of living patients have retained their prosthesis and 75% of the entire cohort are still functioning with their original ankle replacement or died with the original ankle replacement in place. This study should provide a benchmark for newer designs when they obtain this length of follow-up.

The Influence of Metatarsus Adductus Angle on Fifth Metatarsal Jones Fractures

Abstract ID: Paper 072

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INTRODUCTION: Previous studies have reported increasing metatarsus adductus angle (MAA) to be associated with delayed union and refracture following intramedullary screw fixation of Jones fractures.

The purpose of this study was to determine the influence of MAA on postoperative course following intramedullary screw fixation of Jones fractures. We also sought to identify associations between elevated MAA and both fracture and patient characteristics.

METHODS: We performed a retrospective review of all Jones fractures treated with primary intramedullary screw fixation by 4 foot and ankle fellowship-trained orthopedic surgeons at a single institution from 1995 through 2015. Exclusion criteria included concomitant foot/ankle procedures and revision surgery. Charts were reviewed for patient and injury characteristics, implant, and postoperative course. Radiographs were examined for fracture classification, radiographic union, and MAA. MAA calculations were performed on standard weight-bearing digital radiographs using the traditional method, with the 5th metarso-cuboid joint as a reference. Based on severity of MAA, comparative and correlation analyses were performed. Postoperative data comprised primary endpoints: number of surgical failures (defined as delayed union, nonunion, or refracture) and time to each of radiographic union, weight bearing, and pain resolution. Data were analyzed using independent T test, one-way ANOVA, chi-square, and correlation analyses with significance defined as $p<0.05$.

RESULTS: Fifty-nine feet were reviewed with mean age 30 years, follow-up 9.6 months, and mean MAA 20.9 (SD 6.7). Eleven feet had MAA<15, 18 mild (MAA 15-20), 12 moderate (MAA 20-25), 18 severe (MAA>25), and 1 unknown. Comparing the 11 failures (18.6%) to uncomplicated unions, there was no significant difference in mean MAA (24.3 vs. 20.1, $p=0.16$). Three of the 4 nonunion or refracture patients had MAA>25.

MAA was correlated with time to weight bearing ($r=0.365$, $p=0.005$), weight ($r=0.503$, $p<0.001$), BMI ($r=0.280$, $p=0.03$), and approached significance with age ($r=0.230$, $p=0.082$). No significant correlation was found with time to radiographic union.

CONCLUSIONS: To our knowledge, this is the largest series investigating MAA in Jones fracture patients treated with intramedullary screw fixation. Our mean MAA is consistent with previous reports. We found an association between increased MAA and postoperative recovery time, given increased time to weight bearing. We did not find significant associations with prolonged radiographic healing, age, nor failure. The prolonged time to weight bearing may reflect surgeon preference in patients with higher MAA. These results suggest that reported

associations with MAA may not be as strong as previously thought. Further investigation is warranted.

Scarf Osteotomy As A Salvage Procedure for Treatment of Recurrent Hallux Valgus Deformity

Abstract ID: Paper 073

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INTRODUCTION: Symptomatic recurrence of deformity is a known complication following hallux valgus correction. Though rates of symptomatic recurrence have been reported to be as high as 16%, there remains no consensus regarding optimal surgical management. Few studies have investigated the efficacy of proximal first metatarsal “scarf” osteotomy for treatment of recurrent hallux valgus (rHV) deformity. None have analyzed the results in a revision vs. primary setting. We examine radiographic and clinical outcomes of scarf as a salvage procedure for rHV, and compare these outcomes to a control cohort treated primarily with scarf.

METHODS: Medical records and radiographs of 41 consecutive patients undergoing scarf for rHV and control group of 94 consecutive patients undergoing scarf for primary hallux valgus were retrospectively reviewed. Demographics, preoperative/postoperative radiographic parameters (HVA/IMA/DMAA/HVIP/sesamoid station/1st MTP joint congruency), preoperative/postoperative patient reported outcome measures(PRO’s) (visual analogue scale for pain(VAS), Foot and Ankle Society(AOFAS) hallux score, Short-Form 36 (SF36) score), perioperative complications, recurrence and/or iatrogenic hallux varus necessitating 1st MTP fusion were recorded. Multivariate analysis was conducted to detect statistically significant differences between groups. P-value of <0.05 was considered to be statistically significant.

RESULTS: Demographics between the two groups including age, gender, laterality, BMI, diabetes, inflammatory arthropathy, tobacco, and corticosteroid use were statistically similar. Length of follow-up was greater in revision cohort ($p<0.00001$).
Radiographic Parameters: Statistically significant differences were detected in HVA/DMAA/HVIP between the cohorts. IMA/sesamoid station/first MTPJ congruency were not statistically different.

PROs:There was no preoperative or postoperative difference in the outcomes recorded. Both groups had statistically and clinically significant improvement in VAS and AOFAS score.

PERIOPERATIVE COMPLICATIONS: A statistically significant difference in the rate of subsequent first metatarsophalangeal joint fusion was detected between the cohorts (12.2% revision vs. 1.06% primary; $p=0.004$).

DISCUSSION: Limited studies exist supporting revision bunionectomy after rHV. Absence of a control group and small sample sizes are flaws in these studies. Revision bunionectomy with scarf results in similar improvements in PROs and correction of radiographic parameters associated with hallux valgus. Complication rates were similar between the two cohorts; except in recurrence/hallux varus in which there was an increased need for surgery in revision bunionectomy. In recurrent bunions, DMAA was markedly higher preoperatively with a trend

towards a greater rate of preoperative joint congruency. This suggests recurrence after bunion surgery is a result of malunion of the first metatarsal. Additionally, there was less increase in HVIP in revision surgery suggesting that most of the recurrent deformity was in a single plane.

A Biomechanical Comparison of Fifth Metatarsal Jones Fracture Fixation Methods – What is the Ideal Construct?

Abstract ID: Paper 074

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INTRODUCTION: Fifth metatarsal base fractures of the metaphyseal-diaphyseal watershed junction (Jones fractures) are commonly treated with surgical fixation in athletes. Intramedullary screw fixation remains the most utilized construct despite reports of non-union and refractures. This paper compares the biomechanical strength of an intramedullary screw with a plantar-lateral plating construct applied to simulated Jones fractures in paired cadaver foot specimens.

METHODS: Twelve pairs of male cadaver feet (mean age 58) were separated into 2 groups (plate or screw) to conduct contralateral comparative testing of two devices with equally numbered right and left feet in each group. For each fifth metatarsal, an osteotomy was created 2.5 cm distal to the proximal tuberosity aimed for the articulation between the fourth and fifth metatarsals to simulate a Jones fracture. The plate group underwent fixation with a 3.0 mm 4-hole low profile titanium locking plate placed plantar-laterally. The screw group underwent fixation with a 40 or 45 mm X 5.5 mm partially-threaded solid titanium intramedullary screw. The osteotomy and fixation were performed leaving all ligamentous and tendinous attachments in place to simulate a surgical procedure. After fixation, the metatarsals were excised for biomechanical testing.

Cyclic cantilever failure testing was conducted using a gradient-fatigue method (force applied at gradually increasing peak-loads). Sinusoidal loading forces at a constant frequency of 0.25Hz were applied to the metatarsal increasing by 2.5 pound-force (lbf) increments per 10 cycles. Testing was concluded once each specimen had completed the prescribed cycles or experienced mechanical failure of the implant or bone. Failure mode, number of cycles to failure (CTF), peak-failure load (PFL), gap width (GW), and video data were recorded. The T-test was used to compare the two groups with a $P<.05$ set for clinical significance.

RESULTS: The failure mode in both groups occurred at the bone-implant interface. No significant difference was found between the plate and screw groups with regard to CTF (21.5 vs. 21 P=0.49), PFL (18.5 lbf vs. 9 lbf, P=0.33), or GW (1.2mm vs. 5.7mm, P=0.13) respectively reported as means.

DISCUSSION/CONCLUSION: This biomechanical investigation suggests planter-lateral plating is a viable option for management of Jones fractures. Although not statistically significant, larger PFL and smaller GW were recognized in the plate group compared to the screw group. This

may hold clinical importance in both primary and revision Jones fracture treatments. The authors are unaware of any prior biomechanical studies comparing plantar-lateral plating and screw fixation for the treatment Jones fractures.

When Dancing to the Beat Causes Fractures to the Feet: A Study of Foot Fractures in Dancers in the U.S. from 2004-2014

Abstract ID: Paper 075

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INTRODUCTION: Dancers place significant strain on their feet, yet no large-scale U.S. epidemiological studies have examined foot fractures in dancers who present to the emergency department (ED). The purpose of this study was to evaluate national epidemiological trends with the aim of preventing future foot fractures in dancers.

METHODS: Over an 11-year period from January 2004 to December 2014, patients with primary diagnosis of foot fracture were identified in U.S. EDs and chronicled by the National Electronic Injury Surveillance System (NEISS) database. Results were narrowed by manual identification of formulations of the word “dance” from the ED narratives. Descriptive epidemiological, bivariate, and chi-square analyses were conducted. Patients were categorized into age-defined subgroups and further stratified with regards to gender, race, location, and consumer product/activity associated with injury. Seasonal variation and manual sort by “class” participation data were also collected.

RESULTS: 12,228 patients were evaluated in NEISS EDs with foot fractures from 2004-2014. The mean age was 25.0 (SD 18.7) years, with 22% male and 78% female. Dancers accounted for 3,902 fractures (32% of total), with 82% female and 18% male dancers. The most common locations of dance-related injury were at place of recreation/sports (31%), other public property (21%), home (10%), and school (8%). Sixty-six percent of foot fractures occurred between ages 11-34, with only 4% in ages less than 3 years or 65 years and older. 12% of foot fractures occurred in the age 6-10 subgroup, with 95% female, the only subgroup with a statistically significant difference between sexes (p=0.004). Race distribution did not vary significantly among the subgroups. Far fewer fractures occurred in Autumn (NE, 260) than Summer (NE, 1,268), Spring (NE, 960), and Winter (NE, 813). Since 2009, foot fractures in dancers have shown a gradual, but significant (p =0.004) decline.

CONCLUSIONS: Foot fractures attributed to dance represent a disproportionately large percentage of total foot fractures in the United States. Spring and Summer months represented the largest portion of foot fractures, which is when most recitals and competitions take place. Having identified risk factors for fracture, including age, gender, and dance class participation, it is essential to develop injury prevention strategies to better protect dancers in the future. Perhaps injury prevention focus should be on dancers of young age in order to develop good habits before they reach the highest-risk age groups (ages 11-34), thus decreasing the risk of injury in those groups.

Full-Text Publication Rates for Podium and Poster Presentations from the American Orthopaedic Foot and Ankle Society Meetings: 2008-2012

Abstract ID: Paper 076

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INTRODUCTION: Abstracts presented at national orthopedic meetings are used to disseminate current research and can significantly influence orthopedic care. They are intended to go on to full-text publication in peer-reviewed journals, but previous studies have demonstrated that a large percentage of abstracts are never published. The purpose of this study is to determine the full-text publication rates of podium and poster presentations from the American Orthopaedic Foot and Ankle Society (AOFAS) Annual meetings between 2008 and 2012.

METHODS: All abstracts accepted for podium and poster presentations from the 2008 to 2012 AOFAS annual meeting were compiled from the programs. Between April and May 2016, PubMed and Google Scholar searches were performed using key words in the abstract title with the first, second, and last authors' names. Results were reviewed for matches to the meeting abstracts, and specific characteristics of the papers were recorded and analyzed. Full-text publication rates for podium and poster presentations were calculated per year, as were the top journals of publication. Continuous data was summarized using mean ± standard deviation and categorical data was summarized using counts and percents. Difference in publication rates between podium and poster presentations was determined by an odds ratio.

RESULTS: From 2008 to 2012, 1262 abstracts were submitted to the AOFAS annual meeting. Overall full-text journal publication rate was 73.7% for podium presentations and 55.8% for posters, with an odds ratio of 2.17 (95% CI, 1.64-2.86). The mean time to publication was 1.53 and 1.37 years for podium and poster presentations, respectively (p=0.124). The top journals for podium abstracts were Foot and Ankle International (FAI, 50.4%), The Journal of Bone and Joint Surgery (JBJS, 13.0%), American Journal of Sports Medicine (AJSM, 4.3%), and Foot and Ankle Specialist (FAS, 3.2%) and for poster abstracts were FAI (36.9%), Journal of Foot and Ankle Surgery (9.4%), FAS (8.5 %), and JBJS (6.5%).

CONCLUSION: The full-text publication rate was high for podium presentations. Podium abstracts were 2.2 times more likely to be published compared to poster abstracts. The overall full-text publication rate for the AOFAS was one of the higher reported rates compared to other national orthopedic society meetings. The high full-text publication rate may indicate a high level of scrutiny for meeting abstract acceptance and the presentation of high-quality research. The top journal for podium and poster abstracts was FAI, indicating the specialty-focused nature of the material presented.

Foot and Ankle Ability Measure (FAAM) Correlates with PROMIS Function and Psychosocial Outcomes

Abstract ID: Paper 077

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INTRODUCTION: Legacy patient-reported outcome instruments like the FAAM Activities of Daily Living (ADL) quantify patient disability but are often limited by responder burden and incomplete questionnaires. The Patient-Reported Outcome Measurement Information System (PROMIS) overcomes such obstacles through computer-adaptive technology to collect data on various health domains including Physical Function (PF), Pain Interference (PI), and Depression. Few reports, though, have examined PROMIS tools in lower extremity patients, and no study has examined PROMIS psychosocial outcomes like PI and Depression in foot and ankle conditions. We investigated the relationship between FAAM ADL and PROMIS measures, hypothesizing that FAAM ADL and PROMIS scores would correlate.

METHODS: All new patients with either a primary or secondary diagnosis of hallux valgus based on clinic billing codes from July 2015 – February 2016 were retrospectively identified. Patients with complete FAAM ADL paper-based surveys and electronic PROMIS questionnaires for PF, PI, and Depression were included. Spearman rho correlations were performed between FAAM ADL and PROMIS scores. Bivariate and multivariate analyses were then performed to identify differences in FAAM ADL and PROMIS PF measures based on select demographic variables (gender, comorbidities, marital status, employment status, prior foot and/or ankle surgery, and smoking status). Significant variables ($P < 0.1$) from bivariate and multivariate analyses were then entered into stepwise linear regressions to determine which variable(s) determined variance in FAAM ADL and PROMIS PF scores.

RESULTS: Eighty-five patients were identified (13 males, 72 females). FAAM scores significantly correlated with PROMIS PF ($r = 0.70$, $P < 0.001$), PI ($r = 0.65$, $P < 0.001$), and Depression ($r = 0.35$, $P < 0.001$) outcomes. Bivariate and multivariate analyses revealed significantly lower FAAM ADL scores in men ($P = 0.02$) and active smokers ($P = 0.1$). No significant group differences were detected for PROMIS PF scores ($P > 0.1$). Regression analyses demonstrated that PROMIS PI scores alone accounted for significant portions of the variance in FAAM ADL ($R2 = 0.44$, $P < 0.001$) and PROMIS PF ($R2 = 0.57$, $P < 0.001$) measures.

CONCLUSIONS: PROMIS PF, PI, and Depression scores all correlated with FAAM ADL scores, highlighting the importance of understanding functional and psychosocial disability when assessing outcomes in lower extremity patients. Further, PROMIS PI results predicted significant portions of FAAM ADL and PROMIS PF scores, suggesting that function and pain are inter-related when measured by either traditional or modern outcomes instruments.

Rate of Syndesmotic Instability Following Anatomic Posterior Malleolar Fracture Open Reduction and Internal Fixation

Abstract ID: Poster 078

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INTRODUCTION: Ankle fractures are an increasingly common injury due to a more active and aging patient population. Successful long-term outcomes are based on the surgeon's ability to obtain a stable anatomic reduction of the mortise. The goal of our study was to define the rate of syndesmotic instability following the anatomic reduction of the posterior malleolus when posterior stabilization of a trimalleolar ankle fracture was chosen. Conversely, we wanted to evaluate the rate of syndesmotic and posterior instability when a supine position and initially conservative management of the posterior elements was chosen.

MATERIALS AND METHODS: We identified all adult posterior malleolar ankle fractures treated at our institution between January 2012 and December 2015. Exclusion criteria were pilon fractures, trimalleolar fractures with Chaput fragments, and neurologic injury. Demographic information, fracture classification, initial operative position, medial clear space, and posterior malleolar fragment size were recorded for each fracture. We assessed the use and type of syndesmotic and posterior malleolar fixation used in these injuries.

RESULTS: Two hundred six patients were treated at our Level 1 trauma center for posterior malleolar fractures. Forty-seven of 206 (22.8%) patients were positioned prone, which was used as a surrogate for posterior instability based on preoperative imaging. Of these 47 patients, only 1 (2.1%) required syndesmotic fixation after posterior stabilization. One hundred and fifty-nine patients (77.2%) were initially positioned supine. Forty-two (26.4%) of these patients had syndesmotic instability which required operative stabilization. Of these 42 patients, 6 (14.3%) required more fixation for posterior ankle instability. Of the 117 supine patients that did not require syndesmotic stabilization, 39 (33.3%) required posterior malleolar stabilization for posterior instability.

DISCUSSION: Using traditional preoperative estimates of posterior stability may be inadequate. When we positioned patients supine based on small posterior malleolar fragment size, we still needed to stabilize the posterior fragment 28% of the time with a similar number needing syndesmotic fixation. When initial posterior malleolar fixation was chosen, syndesmotic fixation was rare. Based on our results, it may be beneficial to anatomically reduce and stabilize the posterior malleolus at a higher rate to allow for adequate ankle stability.

A Comparison of External Locking Plates vs. Intramedullary Rods for the Treatment of Distal Tibia Fractures

Abstract ID: Paper 079

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PURPOSE (HYPOTHESIS): Compared to intramedullary rods, locking plates used externally to treat distal tibia fractures could produce a similar quality of reduction and fixation while maintaining a low complication rate, without further compromising the blood supply to the fracture site.

METHODS: Two groups of patients with distal tibia fractures were retrospectively reviewed. Only OTA Type 43.A1-A3 fractures were considered for this study. One group of patients was treated with a locking plate placed externally over the skin. The other group was treated with the standard intramedullary rod treatment. The demographics, mechanism of injury, fracture type, mean healing time, and complications were recorded and compared.

RESULTS: The external locking plate group included 28 patients. The average age of this group was 43 (19-63) years old and included 21 men and 7 women. The fracture types for this group were identified as type 43-A1 in 9 cases, type 43-A2 in 9 cases, and type 43-A3 in 10 cases. Seven of these fractures were open. The mean healing time for this group was 16.7 weeks (12-24). There were no implant fractures, malunions, nonunions, deep infections, iatrogenic neurovascular injuries, or recurrent fractures after plate removal. All locking plates were removed in an outpatient setting after the fractures healed. The standard intramedullary rod treatment group had 30 patients. The average age of this group was 41.8 (19-69) years old and included 20 men and 10 women. The fractures types for this group were identified as type 43-A1 in 17 cases, type 43-A2 in 3 cases, and type 43-A3 in 10 cases. Ten of these fractures were open. The mean healing time for this group was 17.8 weeks (9-26) and only included those cases in which the fracture went on to heal completely. The complications found in this group were as follows: 1 case of osteomyelitis, 4 cases of nonunion.

CONCLUSIONS: The external locking plate treatment for distal tibia fractures results in a reduction quality comparable to that of the intramedullary rod treatment. The external locking plate also produced a significantly lower complication rate due to preserving the soft-tissue and medullary blood flow of the tibia. Also, the locking plate has the advantage of being able to be removed in an outpatient setting.

Is it Safe to Prep the External Fixator in situ During Second Stage Pilon Surgical Treatment?

Abstract ID: Paper 080

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BACKGROUND: Intra-articular distal tibia fractures present both bony and soft tissue management challenges. Staged treatment with external fixation followed by definitive internal fixation has become a common treatment to address these challenges. Surgical site infections continue to be a potential problem despite staged treatment. Utilization of a previously placed external fixator in situ offers potential advantages during pilon fracture fixation. The purpose of this study was to assess infection rates when leaving an external fixator in place during definitive tibial pilon fixation.

METHODS: One hundred patients from 1999 to 2014 with pilon fractures treated with a staged protocol leaving external fixators in situ for definitive fixation were retrospectively reviewed. The rates of deep and superficial infections were primary outcomes. Infection rates for open and closed fractures were compared. Subsequent surgical procedures that patients underwent related to their pilon fracture were also recorded.

RESULTS: The deep infection rate was 13% and the superficial infection rate was 11%. Four of 35 (11.4%) patients with open fractures developed a deep infection and 9 of 65 (13.8%) patients with closed fractures developed a deep infection, which were not significantly different (p=1.000). There were 4 transtibial amputations, 4 tibiotalar arthrodeses, 6 bone grafting procedures for nonunion, 7 subsequent soft tissue coverage procedures, and 10 elective hardware removals.

CONCLUSION: The deep infection rate is similar in open and closed pilon fractures when leaving the external fixator in situ during definitive pilon fracture fixation. Overall infection rates using this protocol are comparable to other reported infection rates for two stage surgical treatment of pilon fractures.

A Fracture Boot Stress Model for the Determination of Ankle Stability in Patients with Isolated Distal Fibular Fractures

Abstract ID: Paper 081

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BACKGROUND: The decision to treat isolated fibular fractures operatively relies on the ability to determine ankle stability radiographically. Current studies suggest the ankle must be stressed, by means of either a manual or gravity stress test, to make this determination. We sought to determine if stressing isolated fibular fractures by placing patients in a fracture boot and allowing them to weight-bear as tolerated (WBAT), and obtaining weight-bearing (WB) ankle radiographs at one-week follow-up, would allow us to differentiate stable (SER II) from unstable (SER IV) fractures as compared to current ankle stress tests.

METHODS: This study is a retrospective review of patients with isolated distal fibula fractures managed by our University-based orthopedic department between 2007 and 2012. Inclusion criteria include isolated distal fibula fractures with no widening of the ankle mortise on initial radiographic trauma series, no other injuries prohibiting ipsilateral WB and follow-up extending until time of radiographic healing. Patients fitting the above criteria were managed with a fracture boot and WBAT at time of injury. Follow-up WB ankle radiographs were scheduled one week after injury to determine ankle stability. Ankles with medial clear space (MCS) of >4 millimeters (mm) and 1 mm greater than the superior clear space were treated operatively. Ankles without MCS widening on both initial trauma series and at first WB radiographs were managed with continued WBAT in a fracture boot. Radiographs were repeated at approximately 6 weeks or until radiographic healing occurred. Measurements were performed by two faculty orthopedic surgeons at our institution.

RESULTS: Between 2007-2012, 185 isolated distal fibula fractures were treated at our institution. Seventy-seven patients presented with initial ankle mortise widening and were managed operatively (6 of these were managed non-operatively secondary to medical co-morbidities or patient preference, 3 were lost to follow-up). A total of 87 patients with no initial MCS widening met the inclusion criteria, and were managed per the study protocol. Two of 87 (2.3%), widened at 1 week follow-up with WB radiographs and underwent surgery. The remaining 85 patients were treated non-operatively, and 0/85 patients had evidence of MCS widening on WB radiographs at time of radiographic healing.

CONCLUSION: These results suggest that our fracture boot stress model may be an effect method for the determination of ankle stability in the setting of an isolated fibula fracture. Further investigation with a randomized study comparing our protocol to stress radiographs is warranted.

MAOA BREAKOUT SESSION #7
SPORTS/SHOULDER
April 21, 2017

Pectoralis Major Injuries in the National Football League: Epidemiology, Management, and Outcomes

Abstract ID: Paper 082

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INTRODUCTION: Pectoralis major (PM) injuries are rare and often occur during athletic activity. These injuries have high impact on players and teams, regularly leading to missed time. We aim to determine the incidence of PM injuries among National Football League (NFL) players; investigate whether player position or competition setting put an athlete at increased risk; determine the incidence of operative and non-operative management; and compare time missed between nonsurgical versus surgical management. Lastly, we outline a treatment algorithm for PM injuries.

METHODS: After obtaining NFL Injury and Safety Committee approval, we retrospectively reviewed PM injuries in the NFL injury surveillance system (NFLISS) database from 2000-2014. Injuries were classified as strains and ruptures.

Outcomes were reported by player position, playing conditions, type of play, type of management, days missed, and incidence. A reportable injury is one associated with time loss; an athlete exposure was defined as a single athlete participating in a single practice/game.

RESULTS: 132 PM strains and 79 ruptures were reported. The incidence of PM strain was 0.41/10,000 athlete exposures, and rupture was 0.25/10,000 athlete exposures.

31/132 (23.5%) PM strains occurred during practice, and 101/132 (76.5%) during a game. Of the 101 injured during a game, 32 were offensive players, 61 were defensive players, and 8 were special teams players. Ten (7.6%) required surgery, and 121 (92.4%) were treated conservatively. When treated surgically, mean time missed was 151.2 days (range 8-237, SD 62.9); those treated conservatively missed 18.1 days (range 0-228, SD 28.7).

With PM ruptures, 9/79 (11.4 %) occurred during practice, and 70/79 (88.6%) during a game. Of the 70 injured during a game, 12 were offensive players, 42 were defensive players, and 16 were special teams players. Sixty (75.9%) required surgery, and 19 (24.1%) were treated conservatively. When treated surgically, mean time missed was 146.7 days (range 9-252, SD 55); those treated conservatively missed 77.2 days (range 2-260, SD 72.9).

CONCLUSION: Using the NFLISS to review PM injuries over a 15-year period, we describe the

epidemiology, management, and outcomes. NFL players are at greater risk of injury during in-game situations, and defensive players are most likely to incur injury. Pectoralis strains are primarily treated non-operatively with return to play in 2-3 weeks. Conversely, PM ruptures generally require surgical intervention; on average, players take 147 days to return to sport. This information will allow players and treating physicians to recognize the impact of PM injuries.

Responsiveness of Patient-Reported Outcomes Measures After Shoulder Instability Surgery: A Systematic Review and Meta-Analysis

Abstract ID: Paper 083

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OBJECTIVES: Patient reported outcomes (PROs) are increasingly used in orthopedics as a tool to objectively assess subjective data and provide a sense of responsiveness to treatment. Unfortunately, there are several PROs and little data as to which outcome scores are most useful. The purpose of this study was to evaluate the utilization and responsiveness of PROs reported in the literature after shoulder instability surgery.

METHODS: We performed a systematic review of the PubMed, SportDiscus, Cochrane, and CINHAHL databases according to PRISMA guidelines to identify studies published in the last 10 years which reported PROs after shoulder instability surgery. The specific PROs utilized, number of patients, mean follow-up time, and preoperative and postoperative means and standard deviations were recorded for each article, when available. For studies including preoperative and postoperative means and standard deviations of two or more PROs, the comparative responsiveness of each PRO was assessed using relative efficiency (RE).

RESULTS: Abstracts from 112 studies were identified for full text review, and 29 studies ultimately met inclusion criteria. Sixteen different PROs were reported in various combinations in the included studies. Mean follow-up was 25.17 months (SD = 15.01) and mean sample size was 47.34 (SD = 59.06). The majority of studies (72.4%) utilized more than one PRO. The most commonly used PROs were the ASES (13 studies, 44.8%), Rowe (10, 34.5%), WOSI (8, 27.6%), VAS-pain (7, 24.1%), UCLA (7, 24.1%), and Constant (6, 20.7%). Responsiveness of the different PRO tools was evaluated with a subset of 4 articles that included complete data of sample size, pre- and postoperative means, and pre- and post-operative standard deviations. The Rowe score was much more responsive than both the ASES (RE = 22.8) and Constant scores (RE = 33.17). On the contrary, the VAS-pain was the least responsive, with RE = 0.57 when compared to the ASES, and RE = 0.32 when compared to the WOSI. ASES remained more responsive than the Constant (RE = 1.75), VAS-pain (RE = 1.75), and WOSI (RE = 0.97).

CONCLUSIONS: Despite being less frequently utilized, the Rowe score was considerably more responsive the ASES and Constant scores. ASES, Constant, and WOSI were similar to each other in terms of responsiveness, and the shoulder-specific scores were more responsive than the VAS-pain score. When assessing patient outcomes related to shoulder instability surgery, surgeons may want to consider employing the more sensitive, and instability-specific, Rowe score rather than other commonly used shoulder PROs.

What Do Shoulder Surgeons Really Do? Indications for Arthroscopic Bankart Repair vs. the Latarjet Procedure Among Shoulder Fellowship-Trained Surgeons

Abstract ID: Paper 084

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INTRODUCTION: Scarce data show what fellowship-trained shoulder surgeons actually do when treating recurrent anterior shoulder instability. The purpose of this study was to investigate which factors lead to a Latarjet procedure over an arthroscopic repair. We hypothesized that the Latarjet procedure is utilized primarily for cases of bone loss, revision surgeries, high level contact athletes with minimal bone loss, and for those with >5 dislocations prior to the index procedure.

STUDY DESIGN: Prospective Cohort design; level of evidence, 2.

METHODS: The Multicenter Orthopaedic Outcomes Network (MOON) shoulder group prospectively enrolled patients undergoing surgery for anterior shoulder instability from 16 sites throughout the United States. Patient demographics, initial physical examination findings, and validated, patient-oriented outcome questionnaires were collected. Age, sex, symptom duration, number of dislocations, sport, history of prior stabilization procedure, Hill-Sachs and glenoid-sided percent bone loss, pain level, and failure of conservative treatment were all recorded. Statistical analysis was performed with Fisher's exact test and logistic regression analysis.

RESULTS: Four hundred seventy-seven patients with a history of surgical treatment for anterior shoulder instability were identified. Of these patients, 422 underwent arthroscopic stabilization, and 55 underwent a Latarjet procedure. Significant predictors of surgical decision ($p<0.001$) were symptom duration (78% of Latarjet patients had symptoms > 1 year), number of dislocations (44% of Latarjet patients had > 5 dislocations), revision surgery (71% of Latarjet patients), Hill –Sachs lesion size (57% of Latarjet patients had a lesion between 11-20%), and glenoid bone loss (76% of Latarjet patients had 11-30% bone loss). Logistic regression analysis predicted that patients with a 11-20% Hill-Sachs lesion were 9.31x more likely to have a Latarjet, and patients with 11-20% and 21-30% glenoid bone loss were 41.36x and 560.0x more likely to have a Latarjet procedure, respectively. Patients with > 5 dislocations were 7.38x more likely to undergo a Latarjet, and those with prior surgery were 26.60x more likely to have a Latarjet ($p<0.01$). When controlling for revision surgeries and bone loss, prediction models showed athletes involved in high risk sports were 4.39x more likely to have a Latarjet ($p<0.01$).

CONCLUSION: Indications for a Latarjet procedure were humeral and glenoid-sided bone loss, duration of symptoms, number of dislocations, and revision surgeries. The Latarjet procedure was more likely utilized in high risk athletes and for revisions. These prospectively collected data can hopefully provide a future treatment algorithm for recurrent shoulder instability.

Validation of Patient-Reported Outcomes Measurement Information System (PROMIS) in Patients with Operative Biceps Tendinopathy

Abstract ID: Paper 085

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BACKGROUND: Patient reported outcomes (PROs) instruments provide patients with the opportunity to communicate their perspective on their health status and/or their response to treatments while simultaneously decreasing PRO survey question load. We hypothesized that there would be a significant association among PROMIS physical function instruments (PROMIS physical function CAT, PF CAT and PROMIS Upper Extremity, PROMIS UE) and current orthopedic upper extremity PROs in patients with operative biceps tendinopathy. In addition, we hypothesized that neither PROMIS instrument would demonstrate ceiling or floor effects.

METHODS: Patients with operative biceps tendinopathy requiring tenodesis or tenotomy were included in our study. At a preoperative appointment, the Short Form 36 (subscales: Physical Function [SF-36 PF], Pain [SF-36 Pain], and General Health [SF-36 GH]), American Shoulder and Elbow Surgeons Shoulder Assessment Form (ASES), Marx Shoulder Activity Scale (Marx), EQ-5D, PF CAT and PROMIS-UE forms were administered. The associations between instruments were described using Pearson or Spearman rank correlation coefficients with statistical significance set at $P<0.05$. The presence of ceiling or floor effects were defined as more than 15% of individuals scoring the highest or lowest possible total score on a given PRO.

RESULTS: Thirty-two patients were enrolled (50% female). The mean age and BMI of participants was 47.4 years and 30.54 kg/m^2, respectively. The PROMIS PF CAT and PROMIS UE correlated highly with the ASES and SF-36 PF (all $r>0.75$, $p<0.01$). As expected, the PF CAT and PROMIS UE were weakly or unrelated to PROs that covered other health domains including activity level (Marx score) or general health (SF-36 GH). However, there were strong associations between the SF36 pain subscale and the PF CAT ($r=0.79$, $p<0.01$) and PROMIS UE ($r=0.73$, $p<0.01$). There were no ceiling or floor effects found in the PF CAT or PROMIS UE. Mean number of items administered by PF CAT was 4 (range 4-12).

CONCLUSION: In patients with biceps tendinopathy awaiting surgery, the PROMIS PF CAT and PROMIS UE did not show ceiling or floor effects. Furthermore, construct validity of the PF CAT and PROMIS UE was supported by our results that showed high correlations among these PROMIS instruments and currently established physical function PROs. Further investigation of these PROMIS instruments is needed to confirm validity and assess the responsiveness to change in the postoperative patient population.

Why Does the Proximal Biceps Tendon Hurt? A Collagen Profile Analysis of the Symptomatic Long Head of the Biceps Tendon

Abstract ID: Paper 086

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INTRODUCTION: While the exact physiologic role of the long head of the biceps tendon (LHBT) is controversial, the LHBT is a common cause of anterior shoulder pain and dysfunction. Removing a symptomatic LHBT from the glenohumeral articulation in the form of either a tenotomy or tenodesis is a well-accepted treatment for biceps tendon pathology in the setting of various shoulder disorders. However, the pathophysiologic mechanism for the development of a painful LHBT is not well defined. Some tendonopathies appear to be mediated by the inflammatory cascade, while other tendonopathies manifest as a disorganized collagen structure devoid of cell-mediated inflammation. The purpose of this study was to investigate the immunofluorescence (IF) phenotype of a symptomatic LHBT. We tested the hypothesis that the LHBT exhibits an abnormal phenotype devoid of inflammatory cells but with abnormal collagen expression.

METHODS: Ten patients undergoing an arthroscopic evaluation and biceps tenodesis for severe shoulder pain localized to the bicipital groove recalcitrant to conservative measures were included in the study. Patients with glenohumeral arthritis, a full thickness rotator cuff tear, or a bicipital pulley lesion were excluded. The discarded proximal portion of the biceps tendon between the biceps anchor and distal tenodesis site was processed. Histological analysis and IF staining and quantification of the collagen I to collagen III tissue phenotype was then performed, as increasing levels of collagen III is indicative of the body's attempt to heal pathologic tendon tissue.

RESULTS: No inflammatory cells were found in any specimen. Disorganized extracellular matrix was present in all specimens, but otherwise exhibited characteristics of normal tendon on routine Hematoxylin and Eosin (H & E) staining. A mean 45.99% collagen I to 55.01% collagen III ratio was demonstrated with IF analysis, which is significantly greater than the historical 95% collagen I to 5% collagen III ratio used to define normal tendon.

CONCLUSION: Bicipital groove pain is associated with LHBT tissue that exhibits greater collagen III expression than historical controls for normal tendon. Analyzing the collagen profile of the LHBT may be a more sensitive histologic indicator for shoulder tendon disorders which can be devoid of a traditional inflammatory response.

Routine Plain Radiographs in the Setting of Atraumatic Shoulder Pain: Are They Useful?

Abstract ID: Paper 087

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INTRODUCTION: The use of plain radiographs for initial workup of patients with atraumatic shoulder pain is common in practice, but their utility remains questionable. The purpose of our study was to identify the extent to which plain radiographs aid in initial diagnosis and treatment of these patients.

METHODS: All new patients presenting to our office with atraumatic shoulder pain were included in our prospective study and a plain radiograph shoulder series was obtained. Demographic information and history including duration of symptoms were obtained and physical examination performed by a fellowship-trained orthopedic shoulder surgeon. A preliminary diagnosis was recorded and tentative treatment proposed prior to viewing radiographs. Radiographs were then viewed and determination of change in diagnosis or treatment was made.

RESULTS: We identified 343 patients (236 female, 107 male) with a mean age of 59.4 years. Radiographic findings were noted in 213 cases (62%), though the clinical diagnosis was altered following review of the radiographs in 50 (14.6%) of cases. Further, in only 6 (1.7%) cases was treatment course altered following radiographic review. In each of these cases, osseous lesions were identified and patients were sent for orthopedic oncologic evaluation at our institution. Each lesion was determined to be benign. The mean age of patients with treatment change was 55.5 years compared to 59.4 years in those in which treatment was unchanged (p=0.5). The cost of a radiograph to effect a change in management in our study was $6,002.

DISCUSSION AND CONCLUSION: Obtaining plain shoulder radiographs in our study uncommonly changed the diagnosis and rarely altered the treatment plan in a significant way. Patients may be exposed to unnecessary radiation and the healthcare system as a whole may be burdened with the excessive cost of this imaging in the absence of trauma. It is likely that greater attention to physical examination and basic history can allow for accurate diagnosis without the use of radiographs in this patient population.

Cost-Effective Analysis of Rotator Cuff Repairs at Two Large Metropolitan Hospitals from 2010 to 2014

Abstract ID: Paper 088

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INTRODUCTION: Reports estimate 25.6% of adults in their sixties experience a rotator cuff tear (RCT) which increases to 50.0% for those in their eighties. According to the National Survey of Ambulatory Surgery, an estimated 272,148 rotator cuff repairs (RCR) were performed in 2006 and this has steadily increased over 10 years. Several factors including surgical technique, implant costs, surgeon subspecialty training, and associated procedures have been suggested to introduce variability in the cost of RCR. The purpose of this study was to provide an economic analysis study of RCR in a large metropolitan health system.

METHODS: A retrospective cost-identification study design was used to evaluate cost data from two large hospital locations within a metropolitan hospital system. A variety of cost and profit metrics were collected (i.e., surgical supply/material cost, charge to patient, direct costs, indirect costs, net revenue, net income, and contribution margin) and were tested against multiple cost predictors including hospital center, surgeon volume, surgeon subspecialty training, CPT coding, and length of stay. Surgeons were considered “high-volume” if they performed greater than 50 RCR in the study period. Statistical analyses included logistic regression, chi-square cross tab analysis, and multinomial regression.

RESULTS: Overall, 5,899 RCR were performed from 2010 to 2014; 4,828 (82%) at hospital 1, and 1,071 (18%) at hospital 2. Overall, the mean net income was negative for RCR (-$416.80); however, the mean contribution margin was positive ($2,133.00). The majority of the cost was accounted for by basic surgical supplies and dressings and the average annual orthopedic implant cost was $9,748.78. When examining only high-volume surgeons, no correlation existed between overall costs and implant costs. There was significant hospital site variability, specifically average net income and contribution margin, -$795.38 and +$1,912.70, respectively, were significantly different for hospital 1 compared to +$1,289.42 and +$3,128.64, respectively for hospital 2 ($p<.001$, $p<.001$). Certain CPT codes seem to be associated with higher contribution margins, though this association is not statistically significant.

DISCUSSION: The financial burden of a procedure hinges on the expense incurred by the hospital and the contribution margin generated. Our results suggest that overall profitability of RCR is largely dependent on a hospital site’s ability to control indirect costs. Additionally, certain CPT code combinations, and not implant costs or surgeon-specific practices, seem to be associated with a higher contribution margin for RCR. This finding warrants further exploration as it may be an important driver of cost variation in this common orthopedic procedure.

Speed of Recovery After Rotator Cuff Repair

Abstract ID: Paper 089

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INTRODUCTION: Patient expectations following arthroscopic rotator cuff repair relate to improvements in pain, function, and motion. However, the time necessary to achieve these improvements is not well understood. The purpose of this analysis was to gain a better understanding of the speed of recovery and improvement plateau points for pain and function based on an analysis of measured range of motion and patient reported outcome measures (PROMs) with further analysis based on metrics related to the size of the tear.

METHODS: A retrospective analysis of an institutional prospectively collected shoulder surgery registry was performed on 735 patients treated with an arthroscopic rotator cuff repair between 2006 and 2015. An analysis was then performed for preoperative, 3-month, 6-month, 1-year, and 2-year pain (Visual Analog Scale [VAS] Pain), functional (Simple Shouler Test [SST], American Shoulder Elbow Surgeon [ASES], VAS Function, and SANE [Single Assessment Numeric Evaluation]) and measured motion (active elevation and external rotation). Patient satisfaction with surgery was analyzed at each time point. Plateau in Maximal Improvement was defined as the follow-up point at which no subsequent statistically significant improvement was observed between adjacent time intervals (i.e., 3 months to 6 months).

RESULTS: As an entire group, patients treated with arthroscopic rotator cuff repairs continued to see improvements in all PROMs through 12 months. This was true for SST, ASES, SANE, VAS Function, and VAS Pain scores. At 3 months, 74% of improvement pain and 45-58% of functional improvement was realized. However, only 22% of elevation and 45% of abduction improvement was achieved. At 6 months, 89% of improvement pain, 81-88% of functional improvement, 78% of elevation and 81% of abduction improvement was achieved. Overall satisfaction with surgery was 97.4% at 3 months, 96.2% at 6 months, 96.1% at 1 year, and 99.2% at 2-year follow-up. Tear size based on retraction influenced the plateau in recovery. Larger tears (grade 3) were found to have later plateau points for SANE, active elevation, and external rotation. For most functional scores (SST, ASES, VAS Function), there was no difference in the plateau points. Smaller tears (grade 1) had higher preoperative VAS Function and active motion, which continued to remain higher at all time points. Smaller tears also had higher SST scores at 6 months, and higher SANE scores at 3 months when compared to large tears (grade 3). Tear size did not influence preoperative pain levels or postoperative improvement in pain. Fewer anchors required to repair the rotator cuff correlated with higher 3-month SANE and active elevation, greater active external rotation at 3 and 6 months, higher VAS Function scores at all time points, and greater active elevation at 3 months and 6 months. Fewer anchors also correlated with higher pre-op scores for ASES, VAS Function, and all measured motion.

CONCLUSION: Recovery following rotator cuff repair continues to improve over a 12-month period. At 3 months, approximately 75% of pain relief and 50% of functional recovery has been

achieved. Larger tears take longer to maximize range of motion recovery and SANE. Preoperative pain scores and postoperative pain relief following rotator cuff repair are not influenced by tear size.

Does Medicaid Payer Status Affect Patient Outcomes Following Repair of Massive Rotator Cuff Tears?

Abstract ID: Paper 090

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INTRODUCTION: Considering a reported retear rate of up to 50% and poorer reported outcomes for massive rotator cuff repairs (RCR), it is important to identify factors that may influence outcomes. Given the aging population and increasing emphasis on patient outcomes, management of massive rotator cuff tears (RCT) can present a challenge for orthopedic surgeons. Understanding the influence of socioeconomic status and insurance type in a massive RCT population can provide important information on previously undescribed risk factors. The purpose of this study was to identify relationships between Medicaid payer status and patient outcomes following massive RCR.

METHODS: A retrospective review was performed for 29 patients undergoing massive RCR by a single surgeon. Patients were stratified based on insurance type into two cohorts: 14 Medicaid patients (group 1) and 15 non-Medicaid patients (group 2), which served as the control group. Patient demographics, comorbidities, and missed follow-up visits were compared between the two groups. Outcomes scores evaluated preoperatively and at the most recent postoperative follow-up visit included the American Shoulder and Elbow Surgeons Score (ASES), Penn Shoulder Score (PSS), Subjective Shoulder Value (SSV), and range of motion measurements.

RESULTS: No significant differences were found between the Medicaid and non-Medicaid groups in gender, BMI, diabetes, active smoking, morbid obesity, hypertension, or depression. Although Medicaid patients missed more postoperative follow-up visits (28%) compared to non-Medicaid patients (18%), this difference was not significant. The average clinical follow-up for all patients was 7.1 ± 3.5 months with no significant differences between groups in follow-up duration.

Preoperative range of motion and patient-reported outcomes scores were not significantly different. Both groups significantly improved on all patient-reported outcome scores; however, the non-Medicaid group had significantly higher absolute postoperative ASES for Pain ($p = 0.036$) and SSV ($p = 0.031$) scores. While non-Medicaid patients performed better on all patient-reported outcome scores postoperatively, the magnitude of change between the two groups from the preoperative to final follow-up visit was nearly identical for all measures. Both groups experienced excellent, and nearly equivalent, improvement in range of motion measurements.

DISCUSSION: Regardless of insurance type, significant improvements in patient-reported and functional outcome measurements can be expected in patients following massive RCR. However, Medicaid patients should not expect to achieve the same peak patient-reported outcome scores and satisfaction as non-Medicaid patients. Our results report important information that could guide orthopedic surgeons when optimizing management of massive RCT, especially when treating an expanding Medicaid population.

Decreased Shoulder External Rotation and Flexion are Greater Predictors of Injury than Internal Rotation Deficits: Analysis of 132 Pitcher-Seasons in Professional Baseball

Abstract ID: Paper 091

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INTRODUCTION: There is a strong desire to identify modifiable risk factors that when corrected, have the potential to reduce shoulder and elbow injury burden in overhead athletes. The purpose of this work was to determine the impact and predictive capacity of pre-season shoulder and elbow range of motion (ROM) on shoulder and elbow injuries in professional baseball pitchers.

METHODS: Over the course of 6 seasons (2010 to 2015), a comprehensive, preseason assessment of ROM was performed on all pitchers (n=132 pitcher-seasons) invited to Major League Baseball (MLB) Spring Training Camp for a single MLB organization. Shoulder ROM measures included bilateral flexion, internal rotation (IR), external rotation (ER), and horizontal adduction. Elbow measures included extension and flexion. Total range of motion (TROM) and deficits (difference between the dominant and non-dominant [ND] sides) were calculated. Pitcher age, height, weight, and BMI were also included. All non-traumatic, shoulder, and elbow injuries that resulted in at least one day of time out of play for these 132 pitcher-seasons were identified and cataloged. Using multivariate binomial logistic regression analysis to control for age, height, weight, and all other ROM measures, the pre-season ROM parameters and pitcher demographics that were independent predictors of subsequent shoulder or elbow injury during that season were identified.

RESULTS: A total of 53 shoulder (n=25) and elbow (n=28) injuries occurred during these 132 pitcher-seasons. The most significant independent categorical variables that increased injury rates included shoulder ER deficit (ER < ND side +5°) (OR 2.10 and p=0.071 for shoulder or elbow injury; OR 2.40 and p=0.069 for elbow injury) and shoulder flexion deficit (5°< ND side) (OR 2.83 and p=0.042). For continuous variables, the most significant factors included increased shoulder ER deficit, decreased shoulder flexion, increased IR deficit (GIRD), weight, and decreased shoulder ER ($p<0.05$ for all). Mean shoulder flexion was reduced in injured players compared to uninjured players (p=0.007).

CONCLUSIONS: When controlling for player height, weight, age, and all other ROM measures, a number of preseason ROM parameters are independent risk factors for the development of shoulder and elbow injuries for the upcoming season. This is particularly true for ER deficit, flexion deficit, and IR deficit. Although prior work has supported the importance of reducing GIRD in these athletes, this study demonstrates that deficits in ER and flexion are more significant predictors of subsequent injury.

Changing Body Movement Patterns in Nine-Year-Old Baseball Throwers and Implications for the Youth Sports Injury Epidemic

Abstract ID: Paper 092

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INTRODUCTION: Arm injuries in throwing athletes continue to increase. Injuries may be due to multiple variables including inefficient body movement patterns, especially in young baseball throwers. It is unclear if these patterns can be altered in this population.

METHODS: Ten 9-year olds were instructed in unique baseball throwing drills and were asked to participate in a 21-day program. All underwent radar evaluation as well as video evaluation from two vantage points before and after the programs. Throwing arm frontal view humero-thoracic and antecubital angles as well as pelvic angles were measured at the time of front (directional) leg heel/toe down for each of three pitches. Glove side humero-thoracic angles and dominant leg minimum popliteal angles were measured from posteriorly for each of three additional pitches. All angular measurements were performed by a physical therapist blinded to the purposes of the program and study as well as to video chronology. Our hypothesis was that a 21-day program for young throwers would change body movement patterns and improve velocity.

RESULTS: Throwing arm antecubital angle ($p= 0.01$) and humero-thoracic angle ($p=0.03$) as well as dominant leg minimum popliteal angle ($p=0.03$) all decreased with mean decreases of 35, 10, and 8 degrees, respectively. Velocity increased with decreased dominant leg popliteal angles ($p= 0.019$). All but one improved mean velocity; mean velocity increased 2.6 MPH ($p=0.016$).

CONCLUSION: Young baseball throwers can re-train their bodies to accomplish different movement patterns and improved velocity quickly. This may have implications for injury prevention and treatment as we identify ideal body baseball-throwing movement patterns.

Level of Evidence: Level II, Prospective Comparative Study

The Biceps Button Can be Safely Used to Anatomically Repair Distal Biceps Tendon Ruptures Through a Two-Incision Technique: A Cadaveric Study

Abstract ID: Paper 093

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BACKGROUND: No consensus has been reached on the most effective anatomic approach or fixation method for distal biceps repair. It is our hypothesis that, using a cortical biceps button through a two-incision technique, the distal biceps can be safely and anatomically repaired.

METHODS: A two-incision biceps button distal biceps repair was completed on 10 fresh frozen cadavers. The proximity of the guide pin to the critical structures of the forearm, including the posterior interosseous nerve (PIN) and recurrent radial artery (RRA) were measured. The location of repair was mapped and compared to anatomic insertion.

RESULTS: The distal biceps was safely repaired. The average distance from the tip of the guide pin to the PIN nerve was 11.4 mm (range: 8-14 mm). The average distance from the tip of the guide pin to the recurrent radial artery was 12.5 mm (range: 8-19 mm). The distal biceps tendon was repaired to the anatomic insertion site on the tuberosity using the biceps button technique in all specimens.

DISCUSSION: The goal of distal biceps repair is to safely, securely, and anatomically repair the torn biceps tendon to the radial tuberosity. The most common clinically performed techniques (single anterior incision with cortical button, and the double incision procedure with bone tunnels and trough) have limitations. This procedure safely and anatomically repairs the distal biceps tendon.

CONCLUSION: The two-incision biceps button repair described here allows safe and accurate repair of the tendon to the radial tuberosity.

Level of Evidence: V, cadaveric study

Key words: distal biceps repair; biceps tendon; radial tuberosity; two-incision repair

Higher Head of Bed Angle Increases Risk of Cerebral Deoxygenation Events for Upper Extremity Surgery in the Beach Chair Position

Abstract ID: Paper 094

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INTRODUCTION: Positioning in the beach chair position confers numerous benefits for the surgeon, but has been associated with cerebral desaturation events (CDE) leading to grave neurovascular complications, ranging from deafness to death. Numerous risk factors for CDEs have been identified, but to date there has been no investigation into the role of head of bed angle and its contribution to CDEs. The goal of the present study is to investigate if a lower head of bed angle reduces the incidence of CDE is upper extremity surgery in the beach chair position. We hypothesize that higher bed angles would be associated with increased risk of CDEs.

METHODS: Following IRB approval, 98 consecutive patients undergoing elective upper extremity surgery in the beach chair position were enrolled in the study. Cerebral oxygenation monitoring of the left and right frontal cortex was performed using near-infrared spectroscopy. The patient was then positioned according to the surgeon's preference, while the head of bed angle (HOBA) was measured manually from the horizontal with a goniometer. Data was automatically collected every two seconds until the cessation of the case, and patients were placed into one of two groups. The high angle group was defined as a beach chair position greater than 45 degrees, whereas the low group was defined as a beach chair position less than or equal to 45 degrees. Consistent with prior definitions in the literature, a CDE was defined as a decrease in cerebral tissue oxygenation greater than or equal to 20% from baseline values, or below an absolute threshold of 55%.

RESULTS: Eighty-five patients were enrolled in the high-angle group, and 13 were enrolled in the low-angle group. There were no statistically significant differences with regard to age, BMI, comorbid conditions, ASA status or intraoperative use of vasopressors. There was, however, a significant increase in CDE in patients in the high HOBA group. The rate of CDE in the high-angle group was found to be 79.6%, while the rate in the low-angle group was 20.3% ($p=0.02$).

CONCLUSIONS: The head of bed angle is a significant, independent risk factor in the occurrence of CDEs during upper extremity surgery in the beach chair position. Surgeons may consider performing beach chair surgery at lower angles to reduce risk of CDEs.

MAOA BREAKOUT SESSION #8
TRAUMA
April 21, 2017

Poor Outcomes for Obese Trauma Patients who Sustain Orthopedic Fractures: A Retrospective Cohort Study

Abstract ID: Paper 095

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INTRODUCTION: Nearly one third of Americans are classified as obese and this number continues to rise. While literature exists investigating outcomes related to obese trauma patients, data regarding obese trauma patients who have sustained fractures is sparse. The objective of this project was to investigate whether obesity was associated with worse outcomes among these patients.

METHODS: This was a retrospective evaluation using data from an institutional trauma registry at a level 1 trauma center. Between January 2001 and March 2015, all trauma patients who sustained fractures of the pelvis, clavicle, scapula, upper extremity, or lower extremity were identified. A total of 799 patients with an obesity diagnosis were identified from an overall cohort of 10,959 patients. The outcomes that were investigated included length of hospital stay, admission to the intensive care unit (ICU), length of ICU stay, and mortality. Adjusted odds ratios describing the association between obesity and these outcomes were generated with logistic regression controlling for potential confounding variables identified a priori.

RESULTS: When adjusting for sex, race, and age, the adjusted odds ratio (aOR) for obese versus non-obese patients having hospital lengths of stay ≥4 days was 1.52 (95% confidence interval (CI): 1.30 to 1.77). Obese patients were more likely to be admitted to the ICU (aOR=1.43, 95% CI:1.22 to 1.67), more likely to have a length of stay ≥5 days in the ICU (aOR=1.48, 95% CI:1.14 to 1.93), and more likely to experience increased mortality (aOR=1.72, 95% CI:1.13 to 2.62). An additional analysis was conducted across fracture sites. An association between obesity and poor outcomes was found for patients who sustained patella fractures in the setting of multiple fractures. These patients were more likely to have an increased length of hospital stay (aOR=3.55, 95% CI:1.32 to 9.51), be admitted to the ICU (aOR=3.98, 95% CI:1.84 to 8.60), or experience increased mortality (aOR=7.85, 95% CI:1.82 to 33.85). Additionally, obese patients with isolated femoral neck fractures were more likely to

have increased mortality (aOR=4.85, 95% CI:1.02 to 23.10), as were obese patients with isolated humerus fractures (aOR=11.36, 95% CI:1.84 to 70.25).

CONCLUSION: Obesity is associated with worse outcomes among trauma patients who sustain orthopedic fractures. These patients are statistically significantly more likely to experience longer hospital and ICU lengths of stay, have a greater likelihood of ICU admission, and have increased mortality. Further investigation into appropriate management of obese patients is warranted to improve outcomes in this growing population.

Surgical Wound Classification and Surgical Site Infection in the Orthopedic Patient.

Abstract ID: Paper 096

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BACKGROUND: Surgical site infections (SSI) can be a serious complication following surgery. The Center for Disease Control and Prevention (CDC) created a classification system to use perioperatively as a prognostic indicator for SSI. We hypothesize that the classification system represents a poor prognostic indicator for subsequent SSI in orthopedic patients.

METHODS: Nine hundred and fifty-six consecutive cases were reviewed, which were performed by a single orthopedic surgeon. Inclusion criteria: Index surgery within study period, age > 18 years, a minimum of 12 months follow-up. Wounds were classified as 1=clean, 2=clean-contaminated, 3=contaminated, and 4=dirty using the CDC surgical wound classification (SWC). SSI was diagnosed clinically or using labs, imaging, and microbiology data. Patient demographics, BMI, tobacco use, comorbidities, American Society of Anesthesiologist (ASA) score and insurance-type were documented. The wound classes with their respective SSI rates were compared using a Fisher's exact test. Other variables were tested for associations with SSIs including categorical variables, and a univariate linear regression model for continuous variables. The odds ratios (ORs) with 95% confidence intervals (CI) were also calculated. P values < 0.05 were considered statistically significant.

RESULTS: Four hundred patients were included in the analysis. The rate of infection was not significantly different between the classes, p =0.273. Similarly, not significant when class III and IV were combined, p =0.153. The odds of developing SSI among diabetic patients was significantly higher compared to non-diabetics (OR 2.85 [95% CI: 1.08-7.54]), p = 0.028. Similarly, lower extremity injuries had a significantly higher incidence of SSI (20 of 197) compared to upper extremity injuries (3 of 155) or pelvic injuries (4 of 48), p = 0.0038. The use of bone graft was associated with a higher rate of SSI; however, this was not statistically significant. Higher SSI rates were seen in uninsured and Medicaid/Medicare patients, but this too was not statistically significant.

CONCLUSION: The results showed that the CDC wound classification system was not an effective prognostic indicator for SSI in orthopedic patients.

Keywords: Surgical site infection, orthopedic surgery, CDC surgical wound classification

Putting the Brakes on Breaks: Osteoporosis Screening and Fracture Prevention

Abstract ID: Paper 097

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INTRODUCTION: Fragility fractures and osteoporosis are becoming an epidemic around the world. Appropriate screening for osteoporosis and prevention of secondary fractures after the sentinel fragility fracture can decrease morbidity, mortality and significant healthcare costs. The purpose of the project was to implement a screening tool to identify and risk stratify at-risk patients for osteoporosis and evaluate patient knowledge of osteoporosis and fragility fractures in an orthopedic trauma clinic.

METHODS: Patients at least 50 years old that were receiving treatment for a fracture at a rural academic level 1 trauma center orthopedic trauma clinic were interviewed. Patients completed an osteoporosis screening questionnaire and were placed into 1 of 3 risk stratums based on the questionnaire and FRAX score. Lifestyle advice was given to patients at a low fracture risk. A dual-energy x-ray absorptiometry (DXA) scan was ordered for patients at intermediate fracture risk. A referral was initiated for treatment to a bone health specialist in patients at high fracture risk. Twenty patients completed a knowledge-based pre-test/post-test. The screening rate of patients over 50 years and patient osteoporosis- related knowledge gained were the main outcome measures.

RESULTS: Of 297 eligible patients, 291 patients were screened. Screening of eligible patients was 97.7%. One hundred sixty-five patients (56.7%) screened fell into the intermediate or high-risk stratum of which 136 patients (82.4%) were referred for bone mineral density evaluation. One hundred twenty-six patients (43.3%) were considered low risk. For the knowledge-based evaluation portion, patients had a 33% gain in knowledge ($p=0.0004$). The largest knowledge deficit pertained to osteoporosis risk factors and lifestyle management.

CONCLUSIONS: The use of an osteoporosis-screening questionnaire in the orthopedic trauma clinic produced clinically significant improvement in identification of at risk patients. A lack of knowledge regarding osteoporosis and fragility fractures was found to exist among these patients.

Proximal Humerus Fracture with Metaphyseal Extension: Treatment and Outcomes

Abstract ID: Paper 098

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The traditional classification of proximal humerus fractures is based on anatomical parts; however, the extension to the proximal metaphysis was not included in this classification. In order to provide stable fixation of the humeral head, the medial calcar provides critical stability during fracture reduction. We hypothesize that a proximal humerus fracture with metaphyseal extension may result in different treatment considerations and outcomes than other proximal humerus fractures. The purpose of this study is to analyze our experience managing proximal humerus fractures with metaphyseal extension.

A retrospective chart review was performed of consecutive patients over a 5-year period (2010-2014) who underwent surgical treatment for proximal humerus fracture with metaphyseal extension. Patient demographic information including age, co-morbidities, hand dominance, and mechanism of injury were collected. All proximal humerus fractures with fracture extension at least 1 cm distal to the humeral surgical neck were included in the study. Radiographs and operative reports were reviewed to determine fracture classification, fixation details, and time to healing. Clinic notes were used to determine final functional outcomes and complications.

47 patients with unilateral proximal humerus fractures with metaphyseal extension that underwent surgical treatment were included in the study. Mean patient age was 54±16 years old (range 18-86). 43 patients underwent primary open reduction internal fixation (ORIF) with a proximal humerus locking plate, 3 patients underwent delayed ORIF with a proximal humerus locking plate after failed non-operative management, and 1 patient underwent hemiarthroplasty with proximal humeral shaft plating. Utilizing an extended locking construct, the metaphyseal fracture extension was incorporated into the plate fixation in 44 of the 47 patients (94%). Two patients with extensive medial calcar comminution didn’t have fixation of the metaphyseal extension, and 1 patient underwent hemiarthroplasty. Mean final shoulder range of motion was 121° in forward flexion, 106° in abduction, and 42° in external rotation. The mean time to healing was 2.7 months with all but one fracture healed by 4 months. 8 patients (17%) had complications including infection, AVN, and intra-articular screw penetration.

Previously, fractures of the proximal humerus with metaphyseal extension have not been critically analyzed. In our experience, ORIF using proximal humeral locked plating with incorporation of the metaphyseal extension is an effective treatment strategy. Although the medial calcar is a critical structure for proximal humerus stability, in the majority of fracture settings, this can be incorporated into an elongated locking construct without the need for hemiarthroplasty.

Extra-Articular Malunions and Nonunions of the Scapula: A Comparison of Functional Outcome Before and After Reconstruction

Abstract ID:Paper 099

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BACKGROUND/PURPOSE: Poor functional outcomes have been reported in patients following non-operative treatment of displaced scapular fractures. Surgical reconstruction has yielded good functional outcomes in patients with symptomatic malunion of scapular fractures. This study includes the largest cohort to date and aims to assess surgical and functional results after reconstruction of malunited and nonunited scapular fractures in patients who presented with chronic pain and limitations in range of motion and strength.

METHODS: This study is a retrospective review of 18 patients following reconstruction of scapular malunions and nonunions. There were 13 malunions in 11 patients and 12 nonunions in 9 patients. Several patients had more than one lesion. Two patients had already undergone fixation but healed in a malunited position. All other patients were treated non-operatively initially after injury. The intervention involved surgical osteotomy of the malunion or debridement of the nonunited segment, reduction and internal fixation. Main outcome measures included: pre-/postoperative functional measures of range of motion (ROM), strength, and DASH scores. Return to work was a secondary outcome. A paired student t-test was used to compare shoulder ROM, strength, and DASH scores preoperatively and postoperatively.

RESULTS: Among the 13 of 18 (72%) patients with 2 years or greater follow-up, the mean follow-up was 50 months. Mean age was 50 years. The average time from injury to surgery was 16 months. Preoperative ROM and strength were obtained on 6/13 (46%). There were significant differences between the injured and non-injured shoulders in all measurements preoperatively ($p < 0.05$). Mean DASH score improved from 54 preoperatively to 19 postoperatively ($p=0.0006$). Union was achieved in all cases. At final follow-up, mean ROM (injured/noninjured) was 94% in forward flexion, 97% in abduction, and 81% in external rotation. Mean strength was 72% in forward flexion, 77% in abduction, and 73% in external rotation. There was no significant difference found between the injured and uninjured shoulders in ROM after reconstruction. There were residual significant differences in strength, albeit improved from preoperative. No perioperative complications occurred. Four patients required 5 subsequent procedures: 3 for removal of symptomatic hardware and 2 for manipulation under anesthesia. All reconstructions united without malunion. Ten out of 13 patients returned to their prior occupation.

CONCLUSION: Malunion and nonunion following non-operative treatment of a displaced scapula fracture may be associated with poor functional outcomes; however, reconstruction is associated with a low complication rate, restoration of function, and symptom relief.

Femoral Traction Pin Insertion: Is Lateral Entry as Safe as Medial? An MRI Study

Abstract ID: Paper 100

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INTRODUCTION: Distal femur skeletal traction is an effective method for reduction and temporary stabilization of pelvic, acetabular, or femoral injuries. Traditionally, distal femur traction pins are inserted from the medial side as this is considered the area with the highest risk of injury to the femoral artery traversing the adductor canal. An entry 2 cm proximal to the superior patellar pole (SPP) has previously been advocated as the safest zone. This study aims to characterize the course of the femoral artery as it relates to placement of distal femoral traction pins using a Magnetic Resonance Imaging (MRI) model.

METHODS: MRI studies of the knee were retrospectively analyzed for 50 consecutive adult patients from an IRB approved study. Radiographic software was used on axial MRI slices 2 cm proximal to the SPP to measure the anterior-posterior and medial-lateral distance from the geometric midpoint of the femur to the femoral artery, relative to the trans-epicondylar axis. Medial and lateral soft tissue coverage was measured. Anterior, middle, and posterior entry points were marked on the medial and lateral femoral cortex. The degree of allowable posterior deviation from the ideal trajectory was measured at each point and the angle at which a trajectory abutted the artery was recorded.

RESULTS: The femoral artery was located on average 33.4±4.2 mm posterior and 3.4±3.6 mm lateral to the midpoint of the femur. The average soft tissue thickness over the medial and lateral femur was 45.9 mm and 37.6 mm, respectively. Medially, the average safe posterior deviation at anterior, middle, and posterior entry points was 70.4°, 58.5°, and 52.6°, respectively. Laterally, this was 61.7°, 50.3°, and 39.0°, respectively.

CONCLUSION: Medial traction pin entry has a wider safe zone for avoiding the femoral artery. However, both medial and lateral entry have a wide room for error, so long as the lateral-posterior entry point is avoided. This point poses the highest risk of injury to the femoral artery. Nonetheless, 97.5% of lateral-posterior pins will remain safe when posterior deviation is within 17° of an ideal trajectory. A lateral entry point facilitates more favorable conditions for pin placement as there is less soft tissue coverage over the lateral femur and the contralateral limb is not in the way of equipment needed for pin insertion. This should make an accurate pin trajectory easier to attain. Lateral femoral traction pin entry may be preferable to the traditional medial approach.

Biomechanical Analysis of a Combined Pelvic Ring Construct

Abstract ID: Paper 101

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PURPOSE: We utilized a ring technique combining anterior supra-acetabular internal fixator (ASIF) and posterior pedicle screw stabilization for spinopelvic fixation without having to instrument the lumbar spine. The purpose of this study was to biomechanically evaluate the stability and compressive forces of our ring construct and compare them to established percutaneous methods of fixation in vertically unstable pelvic injuries.

METHODS: Four composite pelvises, with simulated anterior posterior compression type III injury, were each assembled with four constructs: an anterior plate + S1 sacroiliac (SI) screw, ASIF + SI screw, ASIF alone, and our combined ring construct. Every construct was tested on each of the pelvises with compressive loading in a single-leg stance. We recorded displacement at the pubic symphysis and SI joint using high-speed video. Ultimate load and displacement were measured, and axial stiffness was calculated. Values were compared using a one-way ANOVA with Tukey methodology for pairwise analysis, multiple comparisons handled with Bonferroni correction.

RESULTS: The anterior plate with the SI screw was able to handle a significantly higher maximal compressive load (192.48 N) than the ASIF with SI screw (149.18 N) and without the SI screw (30.03 N). However, no significant difference was found between the plate with SI screw and ring construct (188.35 N; $p < 0.05$). SI joint stiffness of the plate with SI screw (54.86 N/m), ASIF with SI screw (51.48 N/m), and ring construct (53.94 N/m) did not exhibit significant difference between each other. All three of the constructs were more stiff than the ASIF alone (4.69 N/m; $p < 0.05$). The anterior plate with SI screw did not exhibit any displacement at the pubic symphysis and stiffness at the joint was assumed to go towards infinity. Pubic symphysis joint stiffness with the ASIF with SI screw (23.92 N/m) and ring construct (33.99 N/m) were significantly more stiff than the ASIF alone (3.82 N/m; $p < 0.05$); however, no difference was noted between the two constructs.

CONCLUSIONS: Our ring construct provides biomechanically equivalent maximal compressive loading and stiffness at the SI joint in comparison to established techniques of fixation. Although the ring construct may provide a suitable alternative with increased patient movement and lower cost, anterior plating with SI screw placement remains the gold standard in fixation of unstable pelvic fractures.

Temporal Trends in the Treatment of Geriatric Acetabulum Fractures

Abstract ID: Paper 102

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PURPOSE: The incidence of geriatric acetabulum fractures is increasing. Given the challenges in managing patients with these difficult fractures, we sought to examine the treatment patterns of geriatric acetabulum fractures.

METHODS: The Nationwide Inpatient Sample from 1998 to 2010 was queried using International Classification of Diseases, 9th edition (ICD-9) diagnostic code 808.0 (closed acetabulum fracture) as a primary diagnostic code to identify patients with acetabulum fractures. These patients were clustered according to treatment by ICD-9 procedure codes: surgical fixation (ICD-9 procedure codes 79.19, 79.39 and 78.59), THA (ICD-9 procedure code 81.51), non-operative treatment (ICD-9 procedure codes 79.09 and 79.75 as well as patients with no associated ICD-9 procedure code), and skeletal traction (ICD-9 procedure codes 93.44 and 93.46). Analysis was limited to geriatric patients (age 65 years or older). A weighted sample was generated as per the Healthcare Cost and Utilization Project guidelines. An estimated annual percent change (EAPC) analysis, a form of linear regression, was utilized to determine statistical significance of changes in temporal trends observed over the study period. A $p < 0.05$ was considered statistically significant.

RESULTS: The weighted sample contained 54,579 patients. Over the 13-year period, 6,552 patients underwent surgical fixation (12.0%), 2,017 patients underwent THA (3.7%), 43,863 patients underwent non-operative treatment (80.4%), and 2,147 patients were treated with skeletal traction (3.9%). From 1998 to 2010, the number of patients undergoing surgical fixation increased (471/4,133 [11.4%] vs. 948/4,908 [19.3%]), and the number of patients undergoing THA increased (83/4,133 [2.0%] vs. 241/4,908 [4.9%]). The EAPC for surgical fixation and THA were 4.39% ($p = 0.017$) and 9.96% ($p < 0.001$), respectively. In contrast, the proportion of patients treated non-operatively remained stable over the study period (EAPC -0.50%, $p = 0.098$). Lastly, the proportion of patients treated with skeletal traction decreased over the study period (EAPC -5.82%, $p < 0.001$).

CONCLUSIONS: Despite data suggesting increased mortality, complications, and cost associated with surgical fixation of geriatric acetabulum fractures compared to non-operative treatment, the number of patients undergoing surgical fixation is increasing, and the number of patients undergoing non-operative treatment is unchanged. We suggest that indications for surgical fixation should be carefully considered in this patient population, especially in light of current data showing high rates of conversion to THA after open reduction and internal fixation. Consistent with this recent finding, the rate of THA also increased over the study period.

Tibial Shaft Fractures Treated with IMN in the Setting of an Intact Fibula: What is the Effect on Time to Union?

Abstract ID: Paper 104

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INTRODUCTION: There are numerous established risk factors for tibial shaft fracture nonunion; however, the role of an intact fibula on union rates in isolated tibial shaft fractures remains controversial. This project sought to determine the incidence and cofactors of delayed healing in middle- and distal-third tibial shaft fractures treated with intramedullary nailing (IMN) in the setting of an intact fibula.

METHODS: This study engaged in a retrospective review of patients with middle- and distal-third tibial shaft fractures with intact fibula treated at our institution by IMN over the last ten years. Data collection included a chart review assessing patient demographics and an imaging review to characterize fracture pattern, construct stability and radiographic healing. Delayed union was defined as fractures unhealed six months after index procedure. Nonunion was defined as fractures unhealed more than nine months following index procedure.

RESULTS: A total of 974 patients were treated with IMN for tibial shaft fractures. Seventy-four patients (7.6% incidence) showed an isolated tibial fracture. Forty-two patients (57%) met inclusion criteria. Four patients (9.5%) demonstrated nonunion, and 9 patients (21.4%) showed delayed union for a total of 13 patients (31%) with abnormal healing. Use of a single distal locking screw was found to be a risk factor for nonunion ($p=0.024$, RR 11.3). Use of medial to lateral only distal locking screws was associated with abnormal healing ($p=0.021$, RR 8.6). A nonsignificant trend existed toward valgus ($p=0.089$) and apex anterior ($p=0.091$) angulation in cases of abnormal healing. No significant change in alignment was seen between the initial postoperative images and final follow-up images. There were no significant differences in healing times and union rates between middle- and distal-third tibial shaft fractures. No differences were noted regarding open fracture, or with respect to fracture orientation. Time to full weight bearing and smoking had no significant effect on healing rate.

CONCLUSION: Isolated tibial shaft fractures remain challenging to treat. Media to lateral distal locking screw configuration and fewer distal locking screws were found to be significantly related to abnormal healing. Use of fewer and medial-entry only locking screws likely allow cantilever bending through the intact fibula due to a less stiff construct. There was a trend toward valgus and apex anterior malalignment among delayed unions, reinforcing the importance of anatomic reduction. Consideration for biplanar distal interlocking when treating these injuries should be strongly encouraged.

Segmental Tibia Fractures: An Analysis of Healing and Complication Rates

Abstract ID: Paper 105

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OBJECTIVES: Segmental tibial shaft fractures represent high-energy trauma. While treatment and complications of non-segmental tibial shaft fractures are well defined in literature, there is limited data regarding the associated injuries and outcomes of segmental tibia fractures. We present a multicenter study on segmental tibia fractures, analyzing the most commonly associated injuries, complications, and healing rates.

METHODS: After IRB approval at 2 academic Level 1 trauma centers, a retrospective review was performed to identify all segmental tibia fractures that occurred in patients treated between 2005-2013. Demographics, injury characteristics, treatments, and complications were reviewed. Categories were evaluated and ranked based on frequency of occurrence.

RESULTS: Approximately 3300 tibial shaft fractures were treated between 2005-2013, of which, 108 patients met the inclusion criteria. All fractures were classified as AO Type 42C2. The average age was 42 years old (range 18-75). The most common mechanism of injury was motor vehicle/motorcycle collision (67.5%), followed by pedestrian struck by automobile (22.2%). 73 patients sustained open fractures, while 34 patients developed compartment syndrome. Other musculoskeletal trauma and chest trauma were the two most common associated injuries. The mean Injury Severity score was 29. 95 patients underwent reamed intramedullary nailing of the tibia, 4 underwent open reduction internal fixation, and 2 patients were definitively treated with external fixation. 8 patients underwent amputations of the ipsilateral extremity. The mean length of hospital stay was 13 days (range 3-48). The mean time to union was 27.2 weeks. The delayed union rate was 43% (39/100). The nonunion rate was 9% (9/100).

CONCLUSION: We present the largest series of segmental patients in the existing literature and show a high rate of open fractures, severe systemic injuries, and high delayed union rate. Orthopedic surgeons must balance early surgical treatment with the presence of associated injuries in patients with this high level of trauma.

Malnutrition Increases the Risk of Postoperative Infection and Wound Dehiscence in Patients with Operative Tibia Fractures

Abstract ID: Paper 106

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INTRODUCTION: Malnutrition is a recognized risk factor for postoperative complications and has been well documented in elective procedures, but remains largely unexplored in trauma patients. Our purpose was to assess the annual trends of malnutrition and to determine its prevalence in operative tibia fractures; furthermore, to determine if malnutrition increases the risk of postoperative complications in operative tibia fractures. We hypothesized that malnutrition would increase the risk of postoperative wound infection and wound dehiscence.

METHODS: The Humana Inc. administrative claims database was reviewed from 2008 to 2015. Patients with operative tibia fractures were identified by CPT code. A preoperative diagnosis of malnourished state was defined by ICD-9 codes and patients were divided into malnourished and non-malnourished cohorts. Patients were tracked for one year following operative fixation of tibia fracture for the occurrence of any infection, infection requiring repeat operation, or wound dehiscence. The rates of these complications were compared between malnourished and non-malnourished cohorts using standard statistical techniques.

RESULTS: There were 9,061 total tibia fractures; 8,428 meeting our specified time frame (All Tibia), and 6,261 closed tibia fractures (Closed Tibia) The overall prevalence of malnutrition in tibia fractures was 3.74%. Documented malnutrition in tibia fractures doubled in 2015 compared to 2008, increasing from 2.3%-4.9% (RR 0.63, P< 0.015). When infection and wound dehiscence were combined, All Tibia and Closed Tibia cohorts had significantly increased risk for complication in malnourished patients (RR 1.48, 1.53; P<0.001 and 0.001, respectively). There was significantly increased risk in All Tibia and Closed Tibia groups for any infection (RR 1.69, P<0.0001; RR 1.77, P<0.0015). There was also significantly increased risk for wound dehiscence in malnourished patients in the All Tibia group (RR 1.78, P<0.0031).

CONCLUSIONS: Malnourished patients were at significantly increased risk for all complications and any infection—even when controlling for open fractures. Rates of malnutrition increased steadily from 2008-2015, inferring an increased risk of malnutrition in 2015 compared to 2008. However, this trend is likely a result of increased awareness and testing for malnutrition and does not actually reflect increased rates of malnutrition. The steady increase in yearly reported malnutrition and the low prevalence of malnutrition in our study (3.74%) compared to previous studies using malnutrition biomarkers (44%-58%), leads us to suspect that malnutrition in our study was grossly underestimated and the risk of complications in malnourished patients with operative tibia fractures may be even more profound.

Allgöwer-Donati vs. Vertical Mattress Suture Technique Impact on Perfusion in Ankle Fracture Surgery: A Randomized Clinical Trial Using Intraoperative Angiography

Abstract ID: Paper 107

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OBJECTIVE: The purpose of this study was to evaluate which primary wound closure technique for ankle fractures affords the most robust perfusion as measured by laser-assisted indocyanine green angiography (LA-ICGA): Allgöwer-Donati or vertical mattress.

DESIGN: Prospective, randomized.

SETTING: Level 1 Academic Trauma Center.

PATIENTS/PARTICIPANTS: Thirty patients undergoing open reduction internal fixation (ORIF) for ankle fractures were prospectively randomized to Allgöwer-Donati (n=15) or vertical mattress (n=15) closure. Demographics were similar for both cohorts with respect to age, sex, BMI, surgical timing, and AO/OTA fracture classification.

MAIN OUTCOME MEASUREMENTS: Skin perfusion (mean incision perfusion and mean perfusion impairment) was quantified in fluorescence units with LA-ICGA along the lateral incision as well as anterior and posterior to the incision at 30 separate locations. Minimum follow-up was 3 months with a mean follow-up 4.7 months.

RESULTS: Allgöwer-Donati enabled superior perfusion compared to the vertical mattress suture technique. Mean incision perfusion for Allgöwer-Donati was 51 (SD=13) and for vertical mattress was 28 (SD=10; P<0.0001). Mean perfusion impairment was less in the Allgöwer-Donati cohort (12.8, SD=9) compared to the vertical mattress cohort (23.4, SD=14; P=0.03). One patient in each cohort experienced a wound complication.

CONCLUSION: The Allgöwer-Donati suture technique offers improved incision perfusion compared to vertical mattress closure following ORIF of ankle fractures. Theoretically, this may enhance soft tissue healing and decrease the risk of wound complications. Surgeons may take this into consideration when deciding closure techniques for ankle fractures.

MAOA BREAKOUT SESSION #9
TOTAL KNEE ARTHROPLASTY
April 21, 2017

Patients At Risk: Large Opioid Prescriptions after Total Joint Arthroplasty

Abstract ID: Paper 108

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INTRODUCTION: Postoperative opioids are widely overprescribed. We hypothesize that patients discharged with greater quantities of opioids after Total Knee Arthroplasty (TKA) may be less likely to titrate their use and more likely to request refills.

METHODS: Review of 105 consecutive primary TKA performed by multiple surgeons at a single institution with at least 1 year of follow-up. Exclusion criteria included bilateral TKA, preoperative opioid use, substance abuse, or reoperation within the first three months. Data collected included opioid refills, Knee Society Score (preoperative and follow up), and total and daily morphine equivalent dose (MED) prescribed.

RESULTS: Patients were most commonly discharged on oxycodone (90%), Dilaudid (5%), and Vicodin (1%). In addition, 87% were prescribed Tramadol. The median number of Oxycodone (5 mg) and Tramadol (50 mg) tablets prescribed was 80, for a total prescribed MED 1400 mg (600 mg of oxycodone and 800 mg of Tramadol). The average total prescribed MED was 1405 ± 616 mg (range, 273 to 3250). Refills occurred in 35% (34) of patients with 18% (19) being primary opioid refills and 16% (17) being Tramadol refills. Two refills were needed in 4% (4) and three refills in 1% (1). Patients requiring refills did not differ in total prescribed MED (1521±624 vs. 1349±609, p=0.1), daily prescribed MED (153±10 vs. 155±7, p=0.8), or preoperative KSS (63±16 vs. 60±13, p=0.3). Average follow-up time was 2.4±0.5 years. At latest follow-up, only one patient remained on opioids (Tramadol) for pain related to the operative knee.

CONCLUSION: The quantity of opioids prescribed after TKA varied widely, ranging from a total MED of 273 to 3250 mg. The refill rate did not differ between large prescriptions (≥1400 mg) and smaller prescriptions. Excessive opioid prescriptions should be avoided as they did not decrease the number of refills and pose the risk of divergence and subsequent abuse.

Tranexamic Acid was Safe in THA and TKA Patients with a History of VTE: A Matched Outcome Trial

Abstract ID: Paper 109

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INTRODUCTION: In contemporary THAs and TKAs, tranexamic acid (TXA) has proved efficacious. Many surgeons are interested in expanding its use, including patients with a prior venous thromboembolic event (VTE). Most randomized trials of TXA have excluded patients with prior VTE, leaving meta-analyses and systematic reviews unable to comment on TXA safety in the setting of prior VTE. We determined a matched, retrospective outcome study to be the best available methodology to determine safety of TXA in patients with prior VTE. We specifically asked: in patients with prior VTE, was the rate of recurrent VTE greater in patients who received IV TXA during primary THA or TKA compared to those who did not receive IV TXA?

METHODS: We retrospectively reviewed 1,262 patients (1,620 cases) with a history of VTE who underwent primary THA or TKA between 2000 and 2012. Intravenous TXA was given in 258 (16%) of the cases and not given in 1,362 (84%). VTE rates were evaluated at 90 days postoperatively. Given the rarity of recurrent VTE, patients who experienced a recurrent VTE were 2:1 retrospectively matched against patients who did not experience a recurrent VTE using age (± 5 years), sex, body mass index (± 5 kg/m2), type of surgery, ASA score, and type of chemoprophylaxis.

RESULTS: In patients with prior VTE, the rate of recurrent VTE was not significantly greater in patients who received IV TXA (2.3%; 6/258) compared to in those who did not receive IV TXA (1.8%; 25/1362; p = 0.6). Of the 31 patients who experienced a recurrent VTE, the 2:1 matched control identified 62 patients who did not have a recurrent VTE. That matched outcome analysis demonstrated that IV TXA did not increase the risk of recurrent VTE (OR 0.9; p=0.9).

CONCLUSION: Patients with a history of VTE had a low risk of recurrent VTE (2%) after contemporary THA and TKA, and that rate was not increased with the use of IV tranexamic acid.

SUMMARY: TXA use was safe amongst contemporary THA and TKA patients with a history of VTE; the risk of recurrent VTE was low (~2%) and was not increased with the use of IV TXA.

The Vanishing Calf Clot: The Rate and Fate of Infra-popliteal DVT After Total Joint Arthroplasty

Abstract ID: Paper 110

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INTRODUCTION: Venous thrombo-embolic disease represents a serious source of morbidity and mortality after total joint arthroplasty (TJA). While treatment of proximal deep vein thrombosis (DVT) of the lower extremity is generally accepted, there are no clear guidelines for the management of infra-popliteal DVT. Available studies are controversial and do not specifically address the TJA population. We thus sought to evaluate the rate and fate of infra-popliteal DVT identified by Doppler ultrasonography after TJA.

METHODS: This was a single-surgeon retrospective study looking at 1,036 consecutive patients who underwent unilateral primary TJA, followed by venous Doppler ultrasonography at 3 weeks. We excluded patients with bilateral TJA, revision TJA, and those with a known DVT or pulmonary embolism. Patients with positive Doppler DVT findings underwent a repeat lower extremity Doppler study at 6 weeks. We recorded the location of DVT, treatment, and results of the follow-up Doppler study. Fisher's exact test was used for statistical analysis.

RESULTS: Among 1,036 patients undergoing primary unilateral TJA, 54 (5.2%) were found to have a symptomatic or asymptomatic DVT at the 3-week visit. Of those DVT, 44 (81%) were isolated infra-popliteal DVTs (95% confidence interval 3.1%-5.5%). Fifteen DVTs were confined to the soleal vein and 9 involved more than one deep distal vein. Patients receiving aspirin alone for DVT prophylaxis after TJA and patients undergoing total knee arthroplasty were at higher risk of developing an isolated distal DVT ($p=0.001$ and $p=0.011$ respectively). Patients with distal DVT were treated either with warfarin, enoxaparin, aspirin, or observation. Thirty-eight patients underwent a repeat Doppler study at 6 weeks, and 30 (79%) had completely re-canalized veins, while 6 thrombi were partially re-canalized and 2 were unchanged. No patient had evidence of proximal thrombus migration. Patients treated with aspirin were significantly more likely to get completely re-canalized veins ($p=0.040$). None of the patients with Doppler positive DVT findings at 3 weeks developed symptomatic pulmonary embolism.

DISCUSSION AND CONCLUSION: Asymptomatic and symptomatic infra-popliteal DVTs are not infrequent after TJA. There is no clear consensus on treatment of infra-popliteal DVTs after TJA. In our patient population, these events occur at a rate of 3.1%-5.5% after unilateral primary TJA. Patients undergoing total knee arthroplasty and those receiving aspirin for postoperative DVT prophylaxis are at a higher risk of having an infra-popliteal DVT. Aspirin represents an effective treatment of these events, and more aggressive anticoagulants do not seem to be required.

The Effect of Implant Design on Sagittal Plane Stability: A Randomized Trial of Medial Pivot vs. Posterior Stabilized Total Knee Arthroplasty

Abstract ID: Paper 111

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INTRODUCTION: Up to 20% of total knee arthroplasty (TKA) patients report dissatisfaction with their outcome and the greatest dissatisfaction is with heightened activity and weight-bearing in flexion (WBiF). Sagittal plane instability has been proposed as a factor contributing to patient dissatisfaction following TKA. We aimed to assess the impact of implant design on TKA sagittal plane stability and clinical satisfaction.

METHODS: We performed a prospective, blinded, randomized trial of patients receiving one of two TKA implant designs from the same manufacturer: medial pivot (MP) or posterior stabilized (PS). Sagittal plane stability was assessed by a blinded examiner using a KT-1000 arthrometer one year after surgery at 30 and 90 degrees of knee flexion. Patient reported outcome measures including Patient Reported Outcome Measurement Information System (PROMIS) assessments, Oxford Knee Score (OKS), Knee Society Score (KSS), Forgotten Joint Score (FJS), Veterans Rand (VR-12), and a custom bank of questions targeting patient satisfaction (0-100%) with activities including WBiF, were administered postoperatively. Patients were followed for up to two years. Patient demographics, outcomes, and stability measurements were compared using Student's t-test and Fisher's exact test for continuous and categorical variables, respectively.

RESULTS: 60 patients were randomized and 10 patients elected not to complete the assessments, leaving 50 patients available for study (25 MP, 25 PS). Demographics and comorbidities were similar between groups. The MP group had significantly less sagittal plane motion than the PS group with KT-1000 testing using 30 pounds of anterior force at 30 degrees of knee flexion (5.7 mm vs 10.3 mm, $p<0.001$) but not at 90 degrees (4.2 mm vs. 5.5 mm, $p=0.137$). Range of motion was not significantly different (MP: 109.4 vs. PS: 116.2, $p=0.069$). There were no significant differences in the PROMIS, OKS, KSS, FJS, or VR-12 scores at any time points. The MP group had equivalent survey scores for WBiF activities and non- WBiF activities (78.8 vs .85.8, $p=0.245$), whereas the PS group had lower survey scores for WBiF activities compared to non-WBiF activities (64.2 vs. 83.9, $p=0.012$). Additionally, the MP group had significantly better survey scores for WBiF activities compared to the PS group ($p=0.046$).

DISCUSSION: A medial pivot prosthetic design is more stable in the sagittal plane in mid-flexion compared to a posterior stabilized design. There was no difference in patient reported outcomes, although custom survey data suggests improved satisfaction with medial pivot design during weight-bearing in flexion activities.

Reproducibility and Precision of CT Scans to Evaluate Tibial Component Rotation

Abstract ID: Paper 112

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INTRODUCTION: Component rotation likely plays a greater role on the survivorship and outcomes of total knee arthroplasties (TKAs) than is currently known. Factors that contribute to our knowledge gap include lack of consensus about how the tibial component should be oriented and problems measuring rotation. Malrotation is difficult to assess on plain radiographs, and conflicting techniques are described with the use of CT scans. The goals of this study were to evaluate the precision, inter-observer agreement, and intra-rater reliability of tibial component rotation measured on CT scans.

METHODS: Three fellowship-trained, academic arthroplasty surgeons independently measured tibial component rotation on CT scans of 62 primary TKAs using their methods of choice. Measurements were repeated at least 2 weeks after the initial measurement. The precision of the measurements was assessed using a formal eight-step protocol as the gold standard. Intra-class correlation coefficients (ICCs) were calculated to evaluate precision, inter-observer agreement, and intra-rater reliability (IRR).

RESULTS: Comparison of surgeons' measurement to a validated gold standard revealed only moderate precision for tibial component rotation (ICCs were 0.68, 0.57, and 0.64, respectively). The inter-observer agreement between the three surgeons for tibial component rotation was also moderate (ICC = 0.48). The intra-rater reliability of tibial rotation was excellent (IRR = 0.80).

DISCUSSION: Practicing surgeons measuring tibial rotation were internally consistent, but failed to demonstrate satisfactory precision and inter-observer agreement. We support the adoption of standardized criteria for the measurement of tibial component rotation on CT scans.

Leaving Residual Varus Alignment After Total Knee Arthroplasty Does Not Improve Patient Pain, Function, and Outcomes

Abstract ID: Paper 113

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INTRODUCTION: Recent popularity of “kinematic alignment” and “constitutional varus” has caused some surgeons to leave varus limbs in moderate residual varus after total knee arthroplasty (TKA). The hypothesis of this study is patients whose limb was left in residual varus alignment would have improved outcomes compared to those fully corrected to neutral alignment after TKA.

METHODS: A retrospective review of consecutive primary TKAs performed with navigation was performed. Anatomic tibiofemoral alignment was measured preoperatively and postoperatively on digital radiographs. Knees were categorized as varus, valgus, or neutral based on accepted criteria. Modern Knee Society Scores, EQ5D, walking and stair pain, and UCLA activity level were collected at minimum one-year. Statistical multivariate analysis was performed ($p < 0.05$ significant).

RESULTS: 225 consecutive TKAs were included, 8% were lost to follow-up, leaving 207 TKAs with clinical follow-up at a mean 24.3 months (range, 9-65). Mean age and BMI was 65.5 years and 34.2, respectively. 66.2% of patients were female. 65% of varus knees were corrected to neutral, 27% left in residual varus and 8% corrected into valgus. KSS objective score at latest follow-up was greater in knees corrected to neutral, compared to those left in residual varus ($p = 0.001$); however, knees over-corrected to valgus improved the greatest from preoperative levels in KSS objective score ($p = 0.001$). There was no difference between groups in any other outcome measure ($p > 0.02$), nor with respect to the amount of varus correction measured in 2° increments ($p > 0.02$) with numbers available.

CONCLUSION: Findings fail to support the notion that leaving varus knees in some residual varus and avoiding full correction to neutral alignment during TKA will improve outcome measures and pain. Until longer-term follow-up is obtained, caution is advised when leaving limbs in residual varus after TKA.

Intra-Articular Vancomycin Powder Eliminates Methicillin-Resistant Staphylococcus aureus in a Rat Model of Contaminated Total Joint Arthroplasty

Abstract ID: Paper 114

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INTRODUCTION: Peri-prosthetic joint infection (PJI) following hip and knee arthroplasty (TJA) leads to poor outcomes and exorbitant costs. Topical vancomycin powder (VP) has been shown to decrease infection in many procedures such as spine surgery. The role for VP in the setting of TJA remains undefined. Our aim was to evaluate the efficacy of intra-articular VP in preventing infection in a rat model of contaminated TJA.

METHODS: Thirty-two female Sprague-Dawley rats underwent knee arthrotomy and implantation of a femoral intramedullary wire with intra-articular communication (1 mm). The knee joint was also inoculated with 1.5x10^7 CFU/mL of methicillin-resistant Staphylococcus aureus (MRSA), which was the inoculum shown in a pilot study to reliably produce a surgical site infection. Four treatment groups were employed: (1) no antibiotics (control), (2) preoperative systemic vancomycin, (3) intra-articular VP, or (4) both systemic and intra-articular vancomycin. Animals were sacrificed at postoperative day six, and distal femoral bone, capsule, and the implanted wire were harvested for bacteriologic analysis. Statistical analyses were performed using Wilcoxon rank sum and Fisher exact tests.

RESULTS: There were no postoperative deaths, wound complications, signs of vancomycin-related toxicity, or signs of systemic illness in any of the treatment groups. The groups receiving VP either individually or in combination with systemic vancomycin demonstrated significantly fewer positive cultures compared to the control animals (p=0.001, 0.001, 0.001, and 0.007 for whole animal, bone, capsule, and k-wire, respectively). Additionally, the combined VP and systemic vancomycin treatment was superior in reducing MRSA counts compared to systemic vancomycin alone (p=0.001, 0.007, and 0.026 for whole animal, bone, and k-wire, respectively). Only animals receiving both systemic vancomycin and VP had complete elimination of bacterial contamination.

DISCUSSION: In a rat model of contaminated TJA, use of intra-articular vancomycin powder in combination with systemic vancomycin completely eliminated MRSA bacterial contamination. Animals treated with systemic vancomycin alone had persistent MRSA contamination. This animal study presents data suggesting that the use of intra-articular vancomycin powder for reducing the risk of peri-prosthetic joint infections should be investigated further in clinical studies.

Intra-Wound Administration of Vancomycin Powder in Primary Total Hip and Knee Arthroplasty Reduces Rate of Prosthetic Joint Infection

Abstract ID: Paper 115

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INTRODUCTION: Prosthetic joint infection (PJI) is the most common cause of readmission after TJA. Intra-wound vancomycin powder (VP) has been shown to reduce infection in spine surgery; however, there is no data regarding VP use in primary TJA. This study evaluated the efficacy of intra-wound vancomycin powder in preventing early, deep postoperative infection after primary total hip (THA) and knee (TKA) arthroplasty.

METHODS: A total of 2,319 consecutive primary total knee and total hip arthroplasties were performed by three fellowship-trained arthroplasty surgeons between January 2009 and May 2015 at a single institution. Initiation of VP use in all cases by all three surgeons began on September 2013. After institutional review board approval was received, a retrospective comparative chart review was conducted. Patients undergoing revision surgery were excluded. Along with presence of infection, patient data including BMI, smoking status, presence of diabetes, ASA score, age, and gender were also recorded.

RESULTS: The rate of PJI overall was reduced from 2.3% (31/1373) to 1.3% (12/946) (p=0.055) with administration of intra-wound VP. The most dramatic drop in rates of PJI was seen in morbidly obese patients. Rates of infection in patients with a BMI >50 decreased from 10.9% to 0%.

CONCLUSIONS: Intra-wound VP has been previously shown to provide sub-therapeutic and often undetectable systemic vancomycin concentrations while yielding highly therapeutic concentrations within the joint. Given the low cost and safety of the intervention as well as our findings, administration of intra-wound vancomycin powder represents a reasonable and effective adjunct to reducing acute, deep prosthetic joint infection in primary TJA.

Contemporary Results of I&D with Component Retention for Acute Periprosthetic Knee Infections

Abstract ID: Paper 116

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INTRODUCTION: Reports are variable on the success of irrigation and debridement with component retention (IDCR) of the acutely infected total knee arthroplasty (TKA), and risk factors for failure remain poorly defined. We aimed to evaluate the contemporary outcomes of IDCR combined with chronic antibiotic suppression. Specifically, we evaluated survival free of (1) death, (2) subsequent infection, and (3) component resection.

METHODS: We conducted a single-center retrospective review of 143 primary TKAs that underwent IDCR. Infections within four weeks of the index procedure were defined as acute postoperative infections (API). All others were defined as acute hematogenous infections (AHI). Patients were treated with IV antibiotics for 4-6 weeks, followed by chronic antibiotic suppression. Survival estimates were made using the Kaplan-Meier survival method and proportional hazard regression multivariate analysis was performed.

RESULTS: There were 39 patients with API and 104 patients with AHI. Comparing the API and AHI groups, survival free of subsequent infection was 74% vs. 83% at 1 year, and 60% vs. 57% at 5 years (p=0.81). Male gender was a risk factor for subsequent infection (HR 2.1, p=0.03) and component resection (HR 2.3, p=0.02). Age <60 increased the risk of subsequent infection (HR 2.3, p=0.03) and component resection (HR 3.2, p=0.003). Infection with any staphylococcal species increased risk of death (HR 1.9, p=0.04), subsequent infection (HR 3.3, p=0.0002), and component resection (HR 3.6, p=0.0004). MSIS type A and C hosts did not have significantly different infection outcomes. MSIS local extremity grade (p=0.9), BMI (p=0.6), duration of symptoms prior to IDCR (p=0.2), rifampin combination antibiotic therapy for Staph species (p=0.98), and the presence of a monoblock tibia (p=0.7) had no significant effect on the outcome of IDCR.

CONCLUSION: In a rigorously defined group of acute periprosthetic knee infections treated with modern methods and chronic antibiotic suppression, IDCR produces fair results at 5 years with approximately 60-70% success. Younger male patients with Staphylococcal species are at the highest risk of failure.

SUMMARY: In a rigorously defined group of acute periprosthetic knee infections treated with modern methods and chronic antibiotic suppression, IDCR produces fair results with 60-70% success at 5 years.

Isolated Tibial Component Failure in Total Knee Arthroplasty: A Case Series Evaluating Inflammatory Response vs. Mechanical Failure

Abstract ID: Paper 117

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BACKGROUND: Total knee prostheses are continually being redesigned to improve performance, longevity, and closer mimic kinematics of the native knee. Despite continued improvements, all knee implants, even those with proven design features, have failures. We identified a cohort of patients with isolated tibial component failures that occurred in a popular and successful knee system. Our purpose was to (1) characterize the observed radiographic failure pattern; (2) investigate the biologic response that may contribute to the failure; and (3) to determine if the failure mechanism was of a biological or a mechanical nature.

METHODS: Twenty-one knees from 19 patients met the inclusion criteria of having isolated tibial component failure in a commonly used knee implant system. Radiographs from the primary and revision knee surgery were analyzed for implant positioning and failure pattern, respectively. Inflammatory biomarkers IL-1β, IL-6, and TNF-α were available in 16/21 knees and peripheral CD14+/16+ monocytes were measured in 10 of the above mentioned 16 knee revisions. Additionally, white blood cell (WBC) count, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) were measured to rule out infection as the cause of the cytokine upregulation.

RESULTS: Radiograph findings demonstrated that all of the 21 tibial components were implanted in either neutral or 2-3° varus position, none of the revisions were implanted in valgus. All tibias showed obvious radiographic loosening and failed into varus. The inflammatory biomarkers IL-1β, IL-6, & TNF-α were negative. WBC, ESR, and CRP were normal. Peripheral CD14+/16+ and total CD16+ monocytes measurements were consistent with previous findings of patients with osteoarthritis.

CONCLUSIONS: The findings supported a mechanical failure mechanism rather than that of a wear debris induced inflammatory pattern. The loosening, collapse, and debonding from the cement may have been related to the implantation technique, stresses due to rotational freedom of the implant, or patient characteristics/behavior.

Outpatient Total Knee Arthroplasty is a Safe and Effective Alternative to the Inpatient Hospital Setting: A Matched Cohort Study

Abstract ID: Paper 118

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INTRODUCTION: Recent literature has indicated that a decreased length of hospital stay may reduce complications, healthcare cost, and raise patient satisfaction following total knee arthroplasty (TKA). Traditionally, inpatient TKA was followed by a two to four night hospitalization, primarily due to analgesic requirements and the inability to ambulate safely. The purpose of this study was to determine the safety, efficacy, and expense associated with TKA performed as an outpatient in a free-standing ambulatory surgery center (ASC) compared with traditional inpatient hospital admission.

METHODS: Following institutional IRB approval, a retrospective review of 82 patients who underwent TKA (41 ASC, 41 hospital inpatient) was performed. The cohorts were matched according to age and American Society of Anesthesiologists physical status classification (ASA score). Average age was 57 (range 46 – 71) and average ASA score was 2.4. Primary outcomes included complications, readmissions, reoperations, and cost. Statistical analysis was performed using student't t-test and Fisher's exact test for continuous and categorical data, respectively. P-values were considered significant if less than 0.05.

RESULTS: There were no readmissions or major complications, including deep infection, periprosthetic fracture, or venous thromboembolism in either cohort. Minor wound issues occurred in 4/41 (9.8%) hospital patients and 1/41 ASC patients (2.4%) (p=0.36). Manipulation under anesthesia was the only reoperation for either group, which occurred in 2/41 (4.9%) ASC patients and 1/41 (2.4%) hospital patients (p=1.00). Cost of TKA in the ASC was an average of $26,800 per patient as compared to the national average of $31,124.

CONCLUSIONS: Total knee arthroplasty can be done safely, reliably, and cost effectively in the ASC. Patient selection, pre-operative screening/counseling, and the use of a multimodal pain regimen are critical to minimizing complications and reducing costs. With the increasing emphasis on lower costs and higher patient satisfaction as measures of outcomes, TKA in the ASC is an attractive alternative to traditional in-hospital TKA.

TKA Revision Risks Among Hispanics

Abstract ID: Paper 119

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INTRODUCTION: Limited data suggest that minority populations experience poorer outcomes following total knee arthroplasty (TKA) procedures. TKA outcomes among Hispanics are not well documented in the literature despite the fact that they represent the fastest growing racial/ethnic group in the United States, projected to become the second largest racial/ethnic group by 2050. Some evidence from large healthcare database analyses suggests that postoperative complications and revisions are more common among Hispanics compared to non-Hispanic whites. Here, we report on initial findings of a retrospective and prospective study investigating the impact of race/ethnicity, implant type, diabetes, and BMI on TKA outcomes.

METHODS: Employing both retrospective and prospective arms to follow outcomes as long as 3 years, postoperative data were abstracted from 312 TKA events between 2009 and 2015. All protocols were approved by the institutional IRB and data were entered into a REDCap database. Potential complications (e.g., implant loosening, radiolucencies, infections, and manipulations under anesthesia) were documented, in addition to data on age, sex, race, ethnicity, implant type, and comorbidities. The primary outcome variable was the need for surgical revision and secondarily, revision due to infection.

RESULTS: Stratifying data based on ethnicity, Chi-square analysis indicated an increased risk among Hispanics for TKA revision (all causes) surgery ($p=0.0107$). Further analysis demonstrated that surgery type (primary or revision) is not associated with implant type (metal or all-polyethylene) ($p=0.1101$). Regarding revision TKA in Hispanics versus non-Hispanics odds ratio was 3.3579 (CI=1.2622-8.9331) and relative risk was 1.9170 (CI=1.2796-2.8717).

DISCUSSION AND CONCLUSION: This analysis strongly suggests that Hispanics are at a greater risk for revision surgery (all causes) after TKA. This risk is independent of tibial implant type (metal-backed or all-polyethylene). These data highlight the need for further investigation into the rates and causes of TKA revision surgery among Hispanics and other minority populations.

Survivorship of Metaphyseal Sleeves in Revision Total Knee Arthroplasty

Abstract ID: Paper 120

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INTRODUCTION: Metaphyseal fixation has promising early results in revision total knee arthroplasty (TKA). However, there are limited studies on mid-term results of metaphyseal sleeves to augment fixation or address bone loss. We analyzed perioperative complications, re-revisions, and survivorship free of revision for aseptic loosening of metaphyseal sleeves in revision TKA.

METHODS: Two hundred and eighty patients with 393 metaphyseal sleeves (144 femoral, 249 tibial) implanted during revision TKA from 2006 to 2014 were reviewed. Sleeves were most commonly cemented (55% femoral, 72% tibial). Mean follow-up was 3 years (range, 2-8 years), mean age was 66 years, and mean BMI was 35 kg/m^2. Indications for revision TKA included: reimplantation from a two-stage revision for prosthetic joint infection (PJI) (37%), aseptic loosening (35%), and instability (14%).

RESULTS: In the perioperative period, there was a 12% rate of complications, most commonly intraoperative fracture during component insertion (6.5%). During follow-up, only 8 (2.5%) sleeves required removal: six (2%) during component resection for deep PJI (all were well fixed at time of removal) as well as one (0.8%) femoral sleeve and one (0.8%) tibial sleeve for aseptic loosening. The 5-year survivorship free of revision for aseptic loosening was 96% and 99.5% for femoral and tibial sleeves, respectively. Level of constraint, bone loss, sleeve and/or stem fixation, and revision indication did not significantly affect outcomes.

CONCLUSION: Metaphyseal sleeve fixation during revision TKA has a 5-year survivorship free of revision for aseptic loosening of 96% and 99.5% in femoral and tibial sleeves, respectively. Both cemented and cementless sleeve fixation provides reliable durability at intermediate follow-up.

SUMMARY: Metaphyseal sleeves provide durable fixation at mid-term follow-up with a 5-year survivorship free of revision for aseptic loosening of 96% and 99.5% in femoral and tibial sleeves, respectively.

MAOA BREAKOUT SESSION #10
HIP PRESERVATION AND ARTHROSCOPY
April 21, 2017

Concentrated Mesenchymal Stem Cells Combined with Platelet Rich Plasma is Effective in Treating Pre-Collapse Osteonecrosis of the Femoral Head: A Prospective Study

Abstract ID: Paper 121

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INTRODUCTION: Our institutional standard of care for pre-collapse osteonecrosis (ON) of the femoral head is hip decompression supplemented with autologous bone marrow-derived mesenchymal stem cells (MSCs) and platelet-rich plasma (PRP). The purpose of this study was to report minimum 2-year clinical outcomes of a prospectively collected cohort undergoing this technique and compare patient-specific MSC in vitro performance.

METHODS: Twenty-two patients (11 males, 11 females; 35 hips) with corticosteroid-induced ON were analyzed. Mean age and BMI was 43 years (22-66 years) and 30.7 kg/m^2 (range 21.8-40.9 kg/m^2). Thirty-one hips were Steinberg Stage 2, and 4 hips were Steinberg Stage 1. All patients had a history of oral corticosteroid use, with 14 patients taking corticosteroids at the time of decompression. Absolute cell count and colony forming unit (CFU) assays were used to assess MSC proliferation. Patients underwent pre- and postoperative MRI to assess change in necrotic lesion volume. Mean follow-up was 3 years (range 2-4 years).

RESULTS: Over the course of the study, 2 hips progressed to THA. One patient had a rapid progression to collapse following the decompression, and the other sustained collapse 2 years postoperatively. Survivorship free from THA was 94%. In addition to these 2 failures, 2 patients (4 hips) underwent a second decompression and MSC injection for continued pain. These two patients have not had a THA or progression in stage. There were no complications related to the procedure. Mean concentration of nucleated cells/mL of bone marrow was 2.1x107 (range 2.5x106-6.8x107). Mean CFU was 19 (range 6-36). Patients with disease progression had a significantly lower mean concentration of nucleated cells (5.6x106 vs. 2.3x107, P=0.03) and CFUs (12 vs. 18, P=0.02) compared to those who remained stable. Four hips demonstrated necrotic lesion volume decreases on MRI. Preoperative mean Harris Hip Score was 57 (range 27-85) and 89 (range 61-100) postoperatively (P<0.0001).

CONCLUSION: Following hip decompression and injection of concentrated bone marrow and PRP, the hip joint was preserved in 94% of patients with precollapse ON of the femoral head at short-term follow-up. Bone marrow nucleated cell count and CFU production was positively associated with delay in disease progression, suggesting regenerative efficacy of the biologic adjuvant.

Six-Year Follow-Up of Hip Decompression with Concentrated Bone Marrow Aspirate to Treat Femoral Head Osteonecrosis

Abstract ID: Paper 122

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(Presented by Ian J. Barrett, M.D., Rochester, MN)

Abstract:

INTRODUCTION: Patients with early stages of femoral head osteonecrosis (FHON), in which femoral head collapse has not occurred (Ficat I and II), can be treated with minimally invasive salvage procedures to prevent disease progression. One such procedure is femoral head decompression with injection of concentrated autologous bone marrow aspirate (CBMA). The goal of this study is to report outcomes in patients treated with this technique at a minimum clinical follow-up of 6 years.

METHODS: Sixty hip decompressions with injection of CBMA were performed in 39 patients for the treatment of FHON between June 2007 and May 2010. After excluding those with advanced stage disease, lost to follow-up before 2 years, patients who underwent decompression without injection of CBMA, and patients who had repeat decompression, 39 cases in 27 patients were reviewed at a minimum follow-up of 6 years. Twelve patients (44%) were treated for bilateral disease. Steroids were presumed to be the underlying etiology for ON in 14 patients (52%). Hip preservation at final clinical follow-up was the main outcome measured. Treatment failure was reported in patients with disease progression ultimately requiring total hip arthroplasty (THA). Survival analysis was calculated using a Kaplan-Meier curve. A postoperative questionnaire was used to assess pain relief and patient-reported disability at final clinical follow-up in those with preserved hips.

RESULTS: Eleven of the 39 hips operated (28%) went onto treatment failure, requiring THA. Survival at 1, 2, and 5 years was 82%, 77%, and 74%, respectively. There was a strong correlation between continuation of steroid treatment and treatment failure ($p < 0.001$). Excellent pain relief with no disability was attained in 61% of the preserved hips. Occasional pain at rest or with prolonged activity was reported for 36% of the hips. One patient (4%) reported constant low-grade pain with significant activity limitations and frequent use of gait aides. There were no major complications.

CONCLUSION: We found that the use of hip decompression augmented with CBMA in the treatment of FHON successfully prevented progression to THA in 72% of patients with early stage ON at 6 years. Two thirds of the patients achieved significant pain relief with minimal disability. Most patients that failed treatment did so within the first year postoperatively, and patients in whom ON was associated with steroid use had a significantly higher risk of treatment failure if steroids were continued following decompression.

Clinical Outcomes of Femoral Head Microfracture: A Group-Matched Controlled Study with Minimum Two-Year Follow-Up Outcomes Femoral Head Microfracture

Abstract ID: Paper 123

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BACKGROUND: Microfracture has been a successful procedure in the hip with documented improvement in PRO, VAS, and high patient satisfaction. All studies to date on hip microfracture have predominantly examined acetabular microfracture, and no study has reported exclusively on the results of femoral head microfracture.

PURPOSE: The purpose of this study was to compare the results of patients who underwent femoral head microfracture to a control group who did not require microfracture with greater than two years of follow-up.

METHODS: Between February 2008 and September 2013, there were 15 patients with greater than two-year outcomes after femoral head microfracture at our institution. Exclusion criteria included Tönnis grade greater than one, LCEA <20, inflammatory arthritis of the hip, pre-existing pediatric hip conditions, coxa profunda or protrusio, and abductor repair. A 3:1 group match was performed based on age, gender, BMI, radiographs, and procedures performed. Patient reported outcomes (PROs) including visual analog scale (VAS) for pain, modified-Harris hip score (mHHS), non-arthritic hip score (NAHS), and hip outcome score-sports specific subscale (HOS-SSS) were collected preoperatively and postoperatively at three months and annually thereafter. Patients were asked how satisfied they were on a scale of one to ten. The need for hip arthroplasty and radiographic progression of Tönnis grade were recorded.

RESULTS: Fifteen patients had femoral head microfracture with greater than two year follow-up. The average improvements in mHHS, NAHS, HOS-SSS, and VAS were 17, 19, 30, and 2.8 in the microfracture group as compared to 12, 17, 21, and 3 in the control group. Both groups showed statistically significant improvement ($p<0.05$) in all PROs, and no difference was found between the microfracture group and control group. Hip arthroplasty was required in two patients in the microfracture group as compared to two patients in the control group. There was no progression of Tönnis grade in either group.

CONCLUSION: Femoral head microfracture is a technically difficult procedure, but when performed correctly, results are similar to patients who did not require microfracture. Further study of femoral head microfracture is necessary to continue to support these encouraging outcomes.

MRI Arthrogram (MRA) was Unreliable in Predicting Intraoperative Findings at the Time of PAO in the Dysplastic Hip

Abstract ID: Paper 125

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INTRODUCTION: Labral and cartilage pathology are commonly seen in patients with hip dysplasia, but controversy exists whether this should be treated at the time of a periacetabular osteotomy (PAO). In addition, correlation between magnetic resonance arthrography (MRA) and intraoperative findings in dysplastic hips has not been thoroughly examined. The aim of this study was to assess the accuracy of MRA by comparing the images to the arthroscopic findings in patients undergoing combined hip arthroscopy and PAO.

METHODS: Between 2013 and 2014, 20 dysplastic hips (16 females, average age 26) with preoperative MRA underwent hip arthroscopy and PAO. Intraoperatively, the labrum and acetabular cartilage were graded based on a scale developed by the senior author along with an experienced musculoskeletal radiologist. The labrum was graded 1-3 and the acetabular chondral damage graded 1-4 correlating with the grade of pathology. All MRA were reviewed by an experienced musculoskeletal radiologist who was blinded to the intraoperative findings. Correlations were then made between intraoperative and radiographic findings to determine the accuracy of MRA in evaluating dysplastic hips.

RESULTS: There was an overall poor correlation between MRA and intraoperative findings in our study. Twelve of the hips (60%) were found to have chondrolabral separation intraoperatively with MRA correctly identifying 7 of the 12. When comparing individual cases, the percent agreement was 55% for the labrum (weighted kappa 0.10) with a sensitivity of 65%, and specificity 33%. Eight cases showed acetabular cartilage cleavage or full thickness defects intraoperatively versus one on MRA. The percent agreement for the acetabulum was 25% (weighted kappa -0.03) with a sensitivity of 35% and specificity 67%.

DISCUSSION AND CONCLUSION: In the present study, there was a poor correlation between the MRA and intraoperative findings when using the current grading scheme to classify labral tears and acetabular chondromalacia in dysplastic hips. MRA alone should not be used as a sole indicator as to whether intra-articular work should be done at the time of PAO but should also correlate with clinical symptoms. Dysplastic hips often have a hypertrophic labrum with abnormal internal signal which can obscure the amount of labral damage seen on MRA. On the acetabular side, without traction during MRA, it is possible that the articular cartilage debonding that is seen during arthroscopy is not realized. Further studies need to be performed to determine what hips require intra-articular work at the time of PAO.

Return to Driving After Hip Arthroscopy

Abstract ID: Paper 126

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PURPOSE: There are no current guidelines with respect to return to driving after hip arthroscopy. The purpose of this study was to evaluate patients' braking performance using a modern driving simulator after undergoing a right hip arthroscopy.

METHODS: A prospective study was conducted, and a total of 14 patients scheduled to undergo a right hip arthroscopy procedure were enrolled. A modern driving simulator was used to measure initial reaction time (IRT), throttle release time (TRT), foot movement time (FMT), and brake travel time (BTT). The braking reaction time (BRT) was calculated as the sum of IRT+TRT+FMT while the total braking time (TBT) was calculated as the sum of BRT+BTT. Patients in the experimental group drove in the driving simulator preoperatively to establish a baseline, and then drove again at 2 weeks, 4 weeks, 6 weeks, and 8 weeks postoperatively. A control group of 17 individuals was also enrolled for baseline comparison and to account for a potential learning phenomenon.

RESULTS: At baseline, control participants had significantly faster IRT (P = .02), TRT (P = .0002), FMT (P < .0001), BRT (P < .0001), BTT (P = .001), and TBT (P < .0001) when compared to the experimental group. No learning phenomenon was observed in the control group. The experimental group showed no significant changes in BTT (P = .11, = .04) nor TBT (P = .20, = .03) over the duration of 8 weeks. Although the experimental group did exhibit significant improvements in IRT (P = .002), TRT (P < .0001), FMT (P < .0001), and BRT (P = .0002) between preoperative and 2 weeks postoperative driving sessions, there were no significant changes thereafter. The mean preoperative TBT and 2 weeks postoperative TBT for the experimental group were 3.07 seconds (SD = .50) and 2.97 seconds (SD = .57) respectively.

CONCLUSIONS: This study's findings suggest that patients may return to driving 2 weeks postoperatively from a right sided hip arthroscopy procedure.

Outcomes of Hip Arthroscopy in Adolescents: A Comparison of Acute vs. Chronic Labral Tears. Two Year Minimum Follow-Up

Abstract ID: Paper 127

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BACKGROUND: Hip arthroscopy in adolescent patients is becoming more common and has been shown to be effective in managing various hip pathologies, including labral tears. The purpose of this study was to ascertain whether outcomes of hip arthroscopy in patients under the age of 18 being treated for labral tears differ depending on whether the presentation was acute or chronic. We also present the outcomes of the largest prospectively collected study on hip arthroscopy performed for labral tears in adolescent patients.

METHODS: Patient reported outcome scores (PROs) for patients undergoing hip arthroscopy between April 2008 and December 2013 were prospectively collected and retrospectively reviewed. Patients that were under the age of 18, treated for labral tears, and eligible for 2-year follow-up were included in the cohort, with those that had Tonnis > 0, revision surgeries, and previous hip conditions excluded. The PROs collected were: modified Harris hip score (mHHS), non-arthritic hip score (NAHS), Hip Outcome Score-Sport Specific Scale (HOS-SSS) and Visual Analogue Score (VAS). The overall cohort was assessed for outcomes and a comparison was made between patients who presented acutely and those who present in a delayed fashion. Preoperative and postoperative PROs, as well as ΔPROs between chronic and acute groups were analyzed. Normalcy was assessed using the Shapiro-Wilk Test and variance was assessed using the F-test. Data was then analyzed for significant differences using t-tests, Mann-Whitney U Tests, Welch Tests, and Chi-square analyses; p-values<0.05 were considered statistically significant.

RESULTS: A total of 194 patients met all the inclusion and exclusion criteria, with 157 (80%) having minimum 2-year follow-up. There was significant improvement in all of the PROs for the overall cohort, with an average follow-up of 36.9 months. The only significant differences between the acute and chronic groups found were lower preoperative PROs and greater change in VAS for the acute group. Overall need for revision surgery was 12%, with a significantly higher rate of revision in the acute group (29%) compared to the chronic group (7.6%).

CONCLUSIONS: Hip arthroscopy in adolescent patients being treated for labral tears is safe and effective at 2 year follow-up. PROs are significantly improved over a minimum of 2 year follow-up. While preoperative PRO scores were lower in patients presenting acutely, there were no significant differences in final PRO scores; however, reoperation rate was significantly higher in patients with an acute presentation.

Patient-Reported Outcome Score Utilization in Arthroscopic Hip Preservation: We're All Doing it Differently, If At All

Abstract ID: Paper 128

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PURPOSE: Regarding outcome scores utilized by hip preservation surgeons worldwide, the purpose of this investigation was to determine: which scores, when administered, by whom, and on what platform.

METHODS: A cross-sectional survey was conducted to examine objective clinician-measured and subjective patient-reported hip outcome scores utilized by arthroscopic hip surgeons, including: hip joint-, lower extremity limb-, and arthritis disease-specific, general health, quality of life, pain, activity, spine, and psychiatric indices and scores. Administered to 155 hip surgeons identified from publicly available sources, descriptive statistics were calculated. Heterogeneity was assessed using chi-squared and I2 statistics.

RESULTS: Of 56 respondents, 13% did not collect any patient outcomes. Of 13 possible hip joint-specific outcome scores, the modified Harris Hip Score was most frequently collected (46%), followed by iHOT-12 (41%), and Hip Outcome Score (38%). There was considerable heterogeneity in hip joint-specific PROs (I2 86%). The Short Form-12 was the most common general health score (30%). The Tegner and UCLA Activity scores were collected by 11% of participants. Fifty-nine percent collected outcomes preoperatively, 45% at 3 months, 54% at 6 months, 61% at 1 year, 32% annually. Paper collection was the most common collection platform (46%), and a dedicated research assistant was most frequently the source of data collection (34%).

CONCLUSION: An international cohort of hip preservation surgeons has reported a wide variety of methods for collecting hip outcome scores. As hip preservation evidence continues to evolve, these results should emphasize need for an international initiative standardizing outcome score collection, better quantifying quality of care.

KEYWORDS: Hip arthroscopy, femoroacetabular impingement, hip preservation, outcomes survey, patient-reported outcomes

Clinical Outcomes After Hip Arthroscopy for Patients with Rheumatoid Arthritis: A Matched-Pair Control Study with Minimum Two-Year Follow-Up

Abstract ID: Paper 129

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BACKGROUND: Literature on patients undergoing hip arthroscopy with a diagnosis of rheumatoid arthritis (RA) is scant. The purpose of this study was to assess the minimum 2-year outcomes of patients undergoing hip arthroscopy with a diagnosis of RA in comparison to a control group of patients without RA. Secondarily, this study examined whether the use of disease-modifying anti-rheumatic drugs (DMARDs), affected outcomes for patients with RA.

METHODS: Data was prospectively collected for patients undergoing hip arthroscopy between 2009 and 2013. Exclusion criteria were prior ipsilateral hip surgery, previous hip conditions, and Tönnis grade >1. Patients with a minimum of 2-year follow-up and preoperative RA diagnoses were matched at a 1:2 ratio based on age ±5 years, BMI ±5, and lateral center edge angle (18°-25°, 26°-39°, or >39°) to patients without RA diagnoses. RA cases were further analyzed based on whether or not they were medicated for their RA at the time of surgery. Patient reported outcome scores (PROs), including modified Harris hip score (mHHS), non-arthritic hip score (NAHS), and hip outcome score-sport specific subscale (HOS-SSS) were collected preoperatively and postoperatively at 3 months and annually thereafter, along with visual analogue scale (VAS) for pain, patient satisfaction, revision surgery, conversion to total hip arthroplasty (THA), and complications.

RESULTS: Twenty-six hips in 20 RA patients were matched to a control group of 52 hips in 52 patients. At ≥2-year follow-up, patients with RA reported no significant improvements except NAHS, while the control group significantly improved in all PROs and VAS. Preoperative PROs and VAS were not significantly different between RA and control groups, but ≥2-year PROs and VAS were all significantly lower for the RA group. Further analysis showed that while non-medicated RA patients still had no significant improvement, medicated RA patients had significantly improved in all PROs and VAS at latest follow-up. A relative risk analysis found age >40 increased conversions to THA by 2.66. Rates of future surgeries (arthroscopic or THA) were similar for RA and controls. Neither group reported any major surgical complications.

CONCLUSIONS: This study found that patients with RA undergoing hip arthroscopy do not significantly improve in PROs or VAS and reported significantly lower PROs, VAS, and satisfaction at minimum 2-year follow-up than a matched control group of patients. Patients with RA should undergo thorough workup control of their rheumatologic condition, and should be counseled about expectations prior to indication for arthroscopic hip surgery.

Arthroscopic Iliopsoas Release for Iliopsoas Impingement After Total Hip Arthroplasty

Abstract ID: Paper 130

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INTRODUCTION: Groin pain following total hip arthroplasty (THA) can, at times, be attributed to iliopsoas impingement. Diagnosis is made primarily by clinical history and physical examination with exclusion of infection and aseptic loosening of implants. When conservative management fails, previous reports indicate open psoas release can improve pain and function. Arthroscopic psoas tenotomy has been shown to be a safe alternative in Europe, though previous studies have been limited to small case series or have not adequately evaluated functional improvement. Our study aims to demonstrate functional improvement with arthroscopic psoas tenotomy for iliopsoas impingement following total hip arthroplasty.

METHODS: Between 2012 and 2016, 27 patients who were diagnosed clinically with iliopsoas impingement following total hip arthroplasty subsequently underwent arthroscopic psoas release after failing conservative management. Patients ranged in age from 39 to 79 years old. Preoperative and postoperative functional scores using the Modified Harris Hip Score (MHHS) and Hip Outcome Score (HOS) were calculated with an average follow up of 1 year. Additionally, postoperative pain and range of motion were compared to preoperative evaluations.

RESULTS: Average preoperative MHHS and HOS were 32.4 and 18.5 respectively. At final follow-up, average postoperative MHHS and HOS were 79 and 56 respectively. Additionally, all patients had resolution of their preoperative pain with improved hip range of motion. One patient with a malpositioned acetabular component sustained a hip dislocation postoperatively. No other complications occurred.

CONCLUSION: Arthroscopic psoas release for iliopsoas impingement following total hip arthroplasty is a safe, minimally invasive procedure that demonstrates significant pain relief and functional improvement.

Lateral Femoral Cutaneous Nerve Injuries During Periacetabular Osteotomy: Three-Year Follow-Up

Abstract ID: Paper 131

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INTRODUCTION: Periacetabular osteotomies (PAO) are used to treat acetabular dysplasia in younger patients, but are not without morbidity. Lateral femoral cutaneous nerve (LFCN) injuries are common after PAOs, but the incidence and rate of resolution is not known. The purpose of this study was to determine the incidence of LFCN injuries after PAO using an innovative nerve conduction study (NCS) and to report the long-term patient reported outcomes.

METHODS: We prospectively enrolled 23 patients (24 hips) undergoing PAOs to have pre- and postoperative NCSs at a mean of 12 weeks postoperatively. In addition, patients were followed-up via phone call interview 3 years postoperatively to determine what symptoms were present and/or had resolved, the severity of the symptoms, and if any treatment had been sought for the injury.

RESULTS: 91% of patients reported one or more LFCN symptom postoperatively. The most common symptoms were numbness (91%), tingling (36%), pain (18%), and burning (9%). Mean worst severity of the symptom(s) was 6/10. 63% had NCSs with evidence of a LFCN injury. 37% of patients went on to have complete resolution of symptoms without treatment at a mean 4 months postoperatively. 63% of patients had continued symptoms at 3 years with a mean severity of 2/10. Only 1 patient required treatment for their LFCN injury.

CONCLUSION: The incidence of LFCN injury after PAO is 90%, two-thirds of which can be identified objectively by NCS. Numbness is the most common symptom. Nearly 40% of LFCN injuries completely resolve by 4 months, but two-thirds have symptoms at 3 years, which is higher than expected. Fortunately, less than 4% require treatment.

Periacetabular Osteotomy Can Treat the Structural Disorder That Predisposes to Traumatic Recurrent Native Hip Instability

Abstract ID: Paper 132

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INTRODUCTION: Certain native bony structural abnormalities or iatrogenic conditions may predispose to traumatic recurrent native hip instability. The most common structural abnormalities are acetabular retroversion (with posterior acetabular undercoverage predisposing to posterior hip instability) or hip dysplasia (with anterior and lateral acetabular undercoverage predisposing to anterior hip instability). Only a few case reports have described this condition and its surgical management. The purpose of this study is to describe seven patients with traumatic recurrent native hip instability that were treated with a periacetabular osteotomy (PAO) to address anterior or posterior acetabular deficiency.

METHODS: Seven patients diagnosed with native hip instability were treated at 2 institutions. The mean number of dislocations prior to surgery was 3.4 (range, 1-10). Radiographs were reviewed to describe the structural abnormalities associated with each hip. Based on radiographic features, five patients had a retroverted acetabulum (one patient had a concomitant CAM deformity). Two patients had increased acetabular anteversion. Both of these patients had undergone previous procedures (one with a prior anteverting femoral osteotomy and the other with a prior arthroscopic labral repair).

RESULTS: Five patients underwent anteverting PAO and two underwent classic PAO to increase anterior and lateral coverage. There were no surgical complications or revision surgeries. At a mean follow-up of 63 months (range, 10-192 months) there were no subsequent episodes of hip instability and the PAO normalized the radiographic features associated with the structural deformity.

DISCUSSION AND CONCLUSION: Traumatic recurrent native hip instability is rare. Acetabular retroversion with posterior undercoverage must be present for posterior dislocation to occur without a posterior wall fracture. In cases of recurrent dislocation, PAO is successful in reorienting the native acetabulum into a position that avoids posterior dislocation. If the acetabulum is over-anteverted and previous surgery has either over-resected anterior bone or further increased femoral anteversion rendering the hip unstable, such as seen in this case series, a PAO can be used to salvage this situation. To our knowledge, this is the largest case series assessing the clinical and radiographic outcomes of PAO for the management of native hip instability.

Radiographic Risk Factors and Signs of Abductor Tears in the Hip

Abstract ID: Paper 133

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BACKGROUND: There is a known increased prevalence of abductor tears in patients with increased age and female gender. This study's purpsose is to identify radiographic risk factors (RRF) and radiographic signs of abductor tendon tears.

METHODS: Patients that had intraoperative diagnoses of abductor tear were included in this study. These patients were matched by age within five years, gender, and BMI +/- five years with patients who had no abductor pathology by clinical exam and MRI. An AP pelvis radiograph was performed on all patients. The radiographs were evaluated for RRF (pelvic width, body weight moment arm, abductor moment arm, abductor angle, pelvic height) and signs of abductor tendon pathology (greater trochanteric excrescence). Femoral version was measured on MRI when images were available.

RESULTS: There were 152 patients with abductor tears identified at the time of surgery. All were treated with surgical repair. These patients were matched as described previously. The RRF found were an increased tear drop to tear drop distance (14.8 for abductor tears vs. 14.3 for control group; $p<0.001$), body weight moment arm (11.1 vs. 10.9; $p<0.001$), abductor moment arm (7.8 vs. 7.6; $p<0.001$), decreased femoral anteversion (7.6 vs 10.6; $p=0.045$), and presence of an excrescence (present in 41% vs 3%), ($p<0.001$). An excrescence of the greater trochanter had a specificity of 97%, PPV of 94%, and a positive likelihood ratio of 12.8 for abductor tears.

CONCLUSION: Patients with abductor tears have a wider pelvis, longer abductor moment arm, longer body weight moment arm, less femoral anteversion, and have greater trochanteric excrescence noted on nearly half of patients with an abductor tear. Presence of an excrescence was noted to have a positive predictive value of 90%, specificity of 97%, and positive likelihood ratio of 12.75, suggesting that if noted on radiograph, the care provider should have a very high index of suspicion for abductor tendon tear. Comparing radiographs of patients with and without abductor tears showed that presence of greater trochanter excrescences are strongly associated with abductor tears.

MAOA BREAKOUT SESSION #11
HIP ARTHROPLASTY
April 22, 2017

Randomized Trial of the Effect of Femoral Stem Length on Subsidence and Functional Outcome Following THA: An EBRA-FC Analysis

Abstract ID: Paper 134

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INTRODUCTION: Femoral component subsidence rates following total hip arthroplasty (THA) have been reported as high as 4.2 mm at 2 years. It is also reported in the literature that stems with a subsidence of 1.2 mm/year during the first two years were likely to fail. EBRA-FCA (Ein-Bild-Roentgen-Analyse-femoral component) is a radiographic analysis technique with reported accuracy and reliability in assessing femoral implant subsidence. The aim of this study is to assess the impact of femoral stem length on subsidence and outcome.

METHODS: We performed a prospective, randomized blinded study comparing two femoral implants (short and standard) of the same design from a single manufacturer. 57 patients undergoing THA were randomized into two groups at the time of surgery (27 short stems, 30 standard stems) and all patients were made weight bearing as tolerated immediately following surgery. Patient demographics, radiographs, Veterans Rand 12 (VR-12) and Patient Reported Outcomes Measurement Information System (PROMIS) were prospectively collected at 6 weeks, 3 months, 6 months, 12 months, and 24 months. EBRA-FCA using standard radiographs was performed by a blinded technician to measure stem subsidence.

RESULTS: The average age of the patients were 60 (30 females, 27 males) with no statistical difference in age (p=0.77), race (p=0.12), ethnicity (p=0.12), gender (p=0.79), between the groups. There was no difference between short and standard stem groups in VR-12 mental (p=0.25-0.87) or physical component (p=0.34-0.77), PROMIS Physical Function (p=0.20-0.96), Pain Behavior (0.11-0.95), and Pain Interference (p=0.10-0.62) scores. The EBRA-FCA of 43 patients showed a mean subsidence of 0.82mm ± 2.03 for short stems and 1.90 mm ± 1.14 for standard stems p=0.016. No stems were revised for aseptic loosening and no stems are considered radiographically loose.

CONCLUSION: In this randomized trial, no difference in clinical outcome was linked to stem length. Both short and standard length stems had low magnitudes of subsidence, but short stems were observed to be significantly more stable from time of implantation to latest follow-up.

THA Instability - Looking Past Acetabular Component Malposition

Abstract ID: Paper 135

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INTRODUCTION: Periprosthetic dislocation affects between 1-3% of total hip arthroplasty (THA) patients. While a safe zone for acetabular component placement has been described, the relative contribution of femoral length and offset restoration on dislocation risk has not been defined.

METHODS: After obtaining IRB approval, we identified 75 primary THAs treated with closed reduction or surgical revision for periprosthetic dislocation. The treatment group was compared with a gender and age-matched cohort of 150 primary THAs without a documented hip dislocation. AP radiographs were used to assess acetabular component inclination, femoral length, and femoral offset restoration. Cross-table lateral (CTL) radiographs were used to approximate acetabular and femoral component anteversion using reconstruction targets for acetabular inclination (30-50°), acetabular anteversion (5-35°), and combined anteversion (20-60°). Femoral length and offset relationships were considered short (< 0 mm), at length (0-9.9 mm), or long (>10 mm) when compared to the contralateral lower extremity. Statistical analysis was accomplished using a Fisher's exact test to assess proportional differences between the patient cohorts.

RESULTS: Femoral sided reconstruction concerns were present more often than acetabular component malposition in the dislocation group (70.7% vs. 50.7%, $p=0.02$). Acetabular component malposition had a similar prevalence in the dislocation and non-dislocation groups (50.7% vs. 48%, $p=0.78$), but inclination (22.6% vs. 7.3%, $p=0.002$) and concurrent inclination-anteversion malposition (10.7% vs. 1.3%, $p<0.01$) were more common in the dislocation group. Dislocated hips were more likely to have combined anteversion outside the desired range (37.3% vs. 19.3%, $p<0.01$) and to have either decreased femoral length or offset than control patients (53.3% vs. 11.3%, $p<0.0001$). This included a higher likelihood of being reconstructed short (32% vs. 5.3%, $p<0.001$), with decreased offset (34.6% vs. 8%, $p=0.0001$), or with both reduced length and offset (13.3% vs. 1.3%, $p<0.001$).

CONCLUSIONS: While some patients experience dislocation with appropriately positioned components, both acetabular and femoral component malposition contribute to increased rates of instability. Reduced femoral length and offset contribute to a higher risk of THA dislocation when acetabular components are placed both inside and outside of the safe zone.

Primary THA: Excellent Survivorship of Modern Double Tapered Uncemented Stems at Minimum of Ten Years

Abstract ID: Paper 136

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INTRODUCTION: Despite the fact that tapered uncemented stems have become by far the most commonly used category of femoral implants in North America, there is a paucity of data examining mid- to long-term outcomes of modern implants. The purpose of this study was to examine outcomes of contemporary widely-used tapered uncemented stems with emphasis on implant survivorship and radiographic and clinical outcomes.

METHODS: Between January 2001 and February 2006, 532 primary uncemented total hip arthroplasties (466 patients) were performed with a double tapered uncemented stem matched with an uncemented cup and a crosslinked polyethylene insert. The series was consecutive for this stem type. There were 247 (53%) men and 219 (47%) women with a mean age of 58 years (20-84). Harris Hip Scores (HHS), radiographic results, and Kaplan-Meier survivorship curves were evaluated. Mean follow-up was 11.6 years (10 to 15 years). There were 415 (89%) patients with minimum follow-up of 10 years, with 35 deaths and 16 patients lost to follow-up.

RESULTS: Femoral stem-specific Kaplan-Meier survival was 99.1% at 15 years with no femoral components revised for aseptic loosening. The only stems removed or revised were 4 (0.8%) for infection and 3 (0.6%) for periprosthetic fracture (one early, two late). No surviving stems were radiographically loose at last follow-up. Mean early subsidence was 0.54 mm (95 % CI: 0.42-0.66). Ninety-one percent of femora had evidence of grade 1 metaphyseal stress-shielding at latest follow-up. The revision-free survival of the entire construct including the cup and liner was 93.0% at 15 years. Recurrent instability requiring revision of the acetabular component occurred in 6 patients (1.1%). The postoperative HHS (mean 91; SD 17.6; range 25-100) was significantly improved compared to preoperative values (54; SD 17.4; range 22-75) ($p < 0.0001$).

DISCUSSION/CONCLUSION: Our results confirm excellent mid- to long-term outcomes with 99.1% stem-specific survival at 15 years of a modern uncemented double tapered stem matched with an uncemented cup with crosslinked polyethylene.

The Impact of Metabolic Syndrome on 30-Day Complications Following Total Joint Arthroplasty

Abstract ID: Paper 137

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INTRODUCTION: The arthroplasty population increasingly presents with comorbid conditions linked to elevated risk of post-surgical complications. Current quality improvement initiatives require providers to more accurately assess and manage risk pre- surgically. In this investigation, we assess the effect of Metabolic Syndrome (MetS), as well as the effect of BMI within MetS, on the risk of complication following hip and knee arthroplasty.

METHODS: We queried the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database for total hip or knee arthroplasty cases. 30-day rates of Centers for Medicare and Medicaid Services (CMS) - reportable complications, wound complications, and readmissions were compared between patients with and without a diagnosis of MetS using multivariate logistic regression, with MetS defined by the presence of a BMI >30, hypertension, and diabetes. Arthroplasty cases with a diagnosis of MetS were further stratified according to World Health Organization BMI class, and the role of obesity within the context of MetS was assessed.

RESULTS: Of the 107,117 included patients, 11,030 (10.3%) had MetS. MetS was significantly associated with CMS-complications (OR=1.415, 95% CI 1.306-1.533, p<0.001), wound complications (OR=1.749, 95% CI 1.482-2.064, p<0.001), and readmission (OR=1.451, 95% CI 1.314-1.602, p<0.001). When MetS was assessed by individual BMI class, the BMI>40 group had higher rates of CMS-complications (MetS BMI>40: 7.8%; MetS BMI 35-40: 6.1%; MetS BMI 30-35: 7.2%; No MetS: 5.0%, p<0.001), wound complications (MetS BMI>40: 2.2%; MetS BMI 35-40: 1.4%; MetS BMI 30-35: 1.3%; No MetS: 0.9%, p<0.001), and readmission (MetS BMI 40+: 4.9%; MetS BMI 35-40: 3.9%; MetS BMI 30-35: 4.7%; No MetS: 3.1%, p<0.001). The MetS BMI>40 group was associated with significantly higher risk for CMS-complications, wound complication, and readmission compared to the lower MetS BMI groups.

DISCUSSION: Metabolic syndrome is an independent risk factor for CMS-reportable complications, wound complications, and readmission following total joint arthroplasty. The risk attributable to metabolic syndrome exists irrespective of obesity class, and increases as BMI increases.

A Perioperative Patient Management Support System was Unable to Mitigate the Risk of Hospital Readmission for THA Patients with High ASA Grades

Abstract ID: Paper 138

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INTRODUCTION: Age, race, socioeconomic status, and the number of systemic comorbidities have been individually identified as factors related to increased risk of hospital readmissions following primary total hip arthroplasty (THA). Utilization of a patient management support system has successfully demonstrated to both reduce the length of hospital stay after primary THA, as well as reducing the number of hospital readmissions.

METHODS: We identified all primary THAs performed at a single institution between 2013 and 2015. Patient sex, age at the time of surgery, race, ASA grade, and 120-day readmissions were retrieved from the patient's medical record. The patient's home address was used as a proxy for socioeconomic status, with the estimated median income being estimated as the median household income for patients of similar ethnicity living within their zip code. A binary regression was used to determine if a model of patient factors could accurately predict 120-day readmission after primary THA. Age and socioeconomic status were treated as a continuous variable and all other factors were categorical in nature.

RESULTS: A sample of 889 primary THAs was identified using the above criteria, of which 754 (84.8%) were Caucasian and 124 (13.9%) were African Americans. With the remaining sample of 878 THAs (475 females, 403 males; age 62.1 ± 13.0 years), a model containing age, sex, race, socioeconomic status, and ASA grade was unable to accurately predict the need for hospital readmission ($R2 = 0.02$). When assessed individually, the rates of hospital readmission did not differ by sex or race; however, those with ASA grades I or II had significantly lower readmission rates than patients with ASA grades III or IV.

CONCLUSION: The use of a perioperative patient management system appears to have mitigated the risk of readmission previously associated with age, sex, and race. However, the risk of readmission for patients with greater comorbidity burdens was double that of patients with low ASA grades. Future studies are necessary to determine if additional patient optimization interventions provide cost-effective methods to reduce the risk of hospital readmission in this subset of more complicated patients.

Pain Management in Primary Total Hip Arthroplasty: The Efficacy of Intravenous vs. Oral Acetaminophen

Abstract ID: Paper 139

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INTRODUCTION: Opioids have traditionally played a central role in pain management after joint arthroplasty. The associated adverse events of opioids and the need to optimize patient outcomes and satisfaction have driven the increased use of non-opioid multimodal strategies. Improved pain management that is associated with fewer adverse events has the potential to improve patient outcome, patient satisfaction, decrease length of stay, and decrease the total cost of care.

Acetaminophen, administered orally or intravenously, is commonly incorporated into multimodal regimens as it has a low risk profile and is effective at diminishing post-operative pain. Intravenous acetaminophen is considered by some to be preferable to oral administration due to a quicker onset of action, higher peak plasma levels, a more predictable pharmacokinetic profile, and ease of administration to patients unable to tolerate oral administration. However, intravenous formulations are approximately 10 times to cost of equivalent oral formulations. This increased cost has called into question whether intravenous dosing, instead of oral dosing, is required to achieve the desired clinical outcomes.

METHODS: Two groups were retrospectively reviewed from a single institution including five surgeons. Group 1 received oral acetaminophen preoperatively and Group 2 received an equivalent dose of intravenous acetaminophen preoperatively. Both groups were administered identical multimodal pain management regimens including spinal anesthesia without opioids, periarticular injection, scheduled oral acetaminophen postoperatively, and oral and intravenous opioids administered for subjective pains of 3 or more on a scale of 1-10. Primary total hip arthroplasties performed through both anterior and posterior approaches were included. Patients receiving general anesthesia were excluded. Patients with a diagnosis of inflammatory arthritis, chronic pain syndromes, or chronic narcotics use were excluded. Pain scores were recorded immediately after surgery, at 2, 4, 6, 8, and 12 hours postoperatively. Symptoms of nausea, emesis, delirium, and sedation were assessed. The total amounts of opioids administered were recorded in morphine equivalents.

RESULTS: Group 1 and Group 2 reported similar pain scores at all time points and there was no difference in reported symptoms of nausea, emesis, delirium, or sedation. Morphine equivalents received were not significantly different between the two groups.

CONCLUSION: The use of intravenous acetaminophen in primary total hip arthroplasty was not found to be more efficacious when compared to equivalent dosing of oral acetaminophen. Cost savings can be achieved by using the less expensive oral formulation.

Differences in Postoperative Outcomes Between Total Hip Arthroplasty for Fracture vs. Osteoarthritis

Abstract ID: Paper 140

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INTRODUCTION: Total hip arthroplasty (THA) is a repeatable and reliable intervention with measurable impact on quality of life for patients with degenerative hip conditions. Hip fracture is an increasingly common expanded indication for THA and warrants outcome analysis so as to best inform risk assessment models, public reporting of outcome, and value-based reimbursement schemes.

METHODS: The National Surgical Quality Improvement Program (NSQIP) data file from 2011 to 2014 was used to identify all patients undergoing THA via current procedural terminology (CPT) code 27130. Propensity score matching in a 1:5 fashion was used to compare 2 cohorts: THA for osteoarthritis and THA for fracture. Primary outcomes included Center of Medicare and Medicaid Services (CMS) reportable complications (pneumonia, myocardial infarction, pulmonary embolism, surgical site infection, catheter-associated urinary tract infection, and death), unplanned readmission, post-surgical length of stay, and discharge destination. χ^2 tests for categorical variables, and Student t test for continuous variables were used to compare the two cohorts and adjusted linear regression analysis used to determine the association between hip fracture and THA outcomes of interest.

RESULTS: 58,302 patients underwent elective THA for osteoarthritis and 1,580 patients underwent THA for hip fracture. Successful propensity score matching eliminated differences between cohorts with the exception of functional status. Rates of CMS-reported complications (4.0% vs .10.7%; P<.001), non-home bound discharge (39.8% vs. 64.7%; P<.001), readmission (4.7% vs. 8.0%; P<.001), and mean days of post-surgical hospital stay (3.2 vs. 4.4; P<.001) were greater in the hip fracture cohort. THA for hip fracture was significantly associated with increased risk for CMS-reportable complications (OR 2.67; 2.17-3.28), non-home bound discharge (OR 1.73; 1.39-2.15), and readmission (OR 2.78; 2.46-3.12).

DISCUSSION AND CONCLUSION: Compared to elective THA for osteoarthritis, THA for hip fracture is associated with greater rates of CMS-reported complications, non-home bound discharge, readmission, and increased length of post-surgical stay. Our findings support recent advocacy for the exclusion of THA for fracture from THA bundled pricing methodology and public reporting of outcomes.

Cementing Constrained Liners into Secure Cementless Shells: A Minimum 15-Year Follow-Up Study

Abstract ID: Paper 141

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INTRODUCTION: With the success of cementless acetabular components obtaining durable long-term boney fixation, the surgeon can be presented with the scenario of a well-fixed, well-positioned shell in a low demand patient at high risk for instability. The authors have previously reported short term (minimum 2 year) results using the technique of cementing constrained liners into well-fixed, well-positioned cementless acetabular components. The purpose of the present study is to report the minimum 15-year results using this technique.

METHODS: Prior to 2001, 31 consecutive tripolar constrained acetabular liners were cemented into secure, well positioned cementless acetabular shells at 3 institutions. 16 cases were performed for recurrent instability and 15 for intraoperative instability. The average age at surgery was 72.1 years (range 31 to 91 years). Patients were evaluated for need of revision for failure of the constrained liners as well as revision for any other reason. Radiographs were evaluated for loosening of the acetabular and femoral component and osteolysis.

RESULTS: At minimum 15-year follow-up, 16 patients (17 hips) had died and 14 patients (14 hips) were living. 5 hips required a revision over the follow-up interval. 3 were revised for failure of the constrained liner. In one case, the liner was cemented proud and it pulled out. It was re-cemented with no further dislocations. A second liner fractured at the capturing ring of the constrained device when the patient had a grand mal seizure. It was successfully treated with a second constrained liner. Finally, a third liner failed by liner loosening and was successfully treated with another constrained liner. None of these three hips required further surgery prior to their death or final follow-up. There were two additional revisions. One for infection and one for femoral loosening. No other components were radiographically loose over the 15-year follow-up interval.

DISCUSSION: In the difficult revision population, cementing a constrained liner into a cementless acetabular shell demonstrated durable results with 9.6% of hips revised at 15 years for constrained liner failure, but all were salvaged with a second constrained liner. Only one other case was revised for loosening, femoral.

Rates and Risk Factors for Revision Hip Arthroscopy

Abstract ID: Paper 142

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INTRODUCTION: The number of hip arthroscopy procedures being performed continues to rise. One measure of hip arthroscopy failure is revision arthroscopy. The current work seeks to examine the rate, timing, and risk factors for revision hip arthroscopy.

METHODS: The Humana administrative claims dataset was reviewed from 2007 through the second quarter of 2015 to identify patients undergoing hip arthroscopy using CPT codes and laterality modifiers. Patients with subsequent ipsilateral revision hip arthroscopy were identified and the rates and timing of these revisions were determined. Subgroup analysis was performed to determine effects of gender, age , BMI , osteoarthritis diagnosis, and specific hip arthroscopy procedure on revision rates.

RESULTS: 1807 hip arthroscopy procedures were identified with a revision rate of 4.2% (total of 72 procedures). 43% of revisions occurred within 6 months after the index procedure, and 86% occurred within 18 months. Age < 50 years was the only significant predictor of revision hip arthroscopy with an even distribution across younger age groups. Chondroplasty was the most common procedure leading to revision (47%) followed by labral repair (37.5%). The most common revision procedures were chondroplasty (44.4%) followed by femoroplasty (38.9%). Osteoarthritis, gender, and BMI did not represent significant risk factors for revision.

CONCLUSION: This is one of the largest series reporting revision hip arthroscopy rates. Approximately 4% of hip arthroscopies were revised, with the majority of revisions occurring within 18 months after the index procedure. This revision rate may be compared to our previous study on conversion rates from failed hip arthroscopy to total hip arthroplasty which reported an 8% rate of conversion from failed hip arthroscopy to total hip arthroplasty, more commonly in older patients with osteoarthritis. The current findings suggest older patients and patients with osteoarthritis may undergo other procedures after initial hip arthroscopy, such as total hip arthroplasty rather than revision hip arthroscopy. Chondroplasty was the most common index procedure going on to revision as well as the most common revision procedure. Femoroplasty and acetabuloplasty may often have been coded as chondroplasty prior to 2011, and incomplete resection for femoracetabular impingement has been cited as a common reason for revision hip arthroscopy. Our data corroborates this observation. Lastly, while 63% of revisions occurred in females, gender was not a significant risk factor for revision. These results will help fill the gap in our understanding of rates and timing as well as relevant risk factors for revision hip arthroscopy.

Patient Characteristics and Surgical Factors Associated with Early Reoperation Following Revision Total Hip Arthroplasty

Abstract ID: Paper 143

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INTRODUCTION: Revision total joint arthroplasty has higher rates of morbidity and mortality than primary total joint arthropalsty. Failed revision surgery may have further consequences due to the limited options available for salvage. Our aim was to determine patient characteristics and surgical factors associated with early reoperation following revision total hip arthroplasty (THA).

METHODS: We retrospectively reviewed the association between patient characteristics, surgical factors, and early reoperation following revision THA using a matched case-control design. The source population included all patients at our institution who underwent revision THA from 2005-2013. Case patients (n=95) were defined as those requiring reoperation within 1 year of revision THA. Controls (n=380) were matched at a ratio of 4 controls per case by surgeon, year of surgery, and reason for surgery. American Society of Anesthesiologists (ASA) score, gender, BMI, comorbidities, and duration of surgery were recorded. Chi-square test was used for categorical variables, while t-test was used for continuous variables. Univariate and multiple logistic regression analyses were performed for risk of early reoperation.

RESULTS: History of alcohol abuse (p=0.005), seizure disorder (p=0.0493), or autoimmune conditions (p=0.0201) were risk factors for reoperation within 1 year of revision THA. ASA score, gender, BMI, and duration of surgery were not predictive of early reoperation.

CONCLUSION: Our study suggests patients with history of alcohol abuse, seizure disorder, or autoimmune conditions should be optimized preoperatively and closely monitored postoperatively the year following THA revision surgery due to the increased risk of early reoperation.

Internet Promotion of Direct Anterior Approach Total Hip Arthroplasty by Members of the American Association of Hip and Knee Surgeons

Abstract ID: Paper 144

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INTRODUCTION: The Direct Anterior approach (DAA) in total hip arthroplasty (THA) garners significant interest by both patients and surgeons, largely due to intense marketing by industry, hospitals, and even surgeons. This study addressed the question, 'What is the level of promotion of DAA THA through the internet by American Association of Hip and Knee Surgeons (AAHKS) members?'

METHODS: An internet search was performed to identify surgeon-specific websites for each active member of the AAHKS using the members' full name and a previously published set of criteria. Each website was evaluated utilizing a questionnaire to systematically identify claims made regarding proposed DAA specific risks, benefits, as well as presence/absence of supporting data.

RESULTS: 1,631 active AAHKS members were found to have 1,807 qualified websites. The DAA was referenced on 22.6% (408/1807) of these websites. Claims regarding DAA specific benefits identified on these 408 websites included; less invasive/muscle sparing (45.8%), quicker recovery (44.1%), decreased pain (27.9%), decreased hospital stay (21.8%), decreased dislocation (16.2%), and decreased leg length discrepancy (7.8%). Potential DAA risks including lateral femoral cutaneous nerve injury, peri-prosthetic/greater trochanteric fracture, and wound complication/hematoma were addressed on only 4.9%, 3.2%, and 2.9% of websites, respectively. Supporting peer-reviewed literature was identified on only 6.7% (15/408) of DAA websites.

CONCLUSIONS: Over one-fifth of AAHKS members promote the DAA on the internet. Member websites claimed DAA benefits such as faster recovery and decreased pain approximately nine times more frequently than any potential risk of the procedure ($p < 0.001$). Reference to peer-reviewed literature to support claims was rare. While AAHKS policy does not regulate member marketing, it is the responsibility of all orthopedic surgeons to disseminate accurate, validated information concerning the procedures we perform.

Early Patient Reported Lateral Femoral Cutaneous Nerve Symptoms After Direct Anterior Total Hip Arthroplasty

Abstract ID: Paper 145

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INTRODUCTION: Patient reported rates of lateral femoral cutaneous nerve (LFCN) neurapraxia type symptoms after total hip arthroplasty (THA) through a direct anterior (DA) approach vary within the literature reaching >70%. This has not been our clinical experience; therefore, our purpose with this study was to (1) report on our incidence of LFCN symptoms, (2) assess the early natural history of these symptoms, and (3) to identify associated risk factors.

METHODS: We evaluated 75 sequential patients in clinic who presented for their first routine follow-up after undergoing a primary THA through a DA approach. A Douleur Neuropathique 4 (DN4) questionnaire, a screening tool for neuropathic pain, was filled out based on patient-reported lateral thigh symptoms experienced postoperatively, with a score of ≥ 4/10 signifying neuropathic pain. These same patients were then contacted by telephone 3-6 months after their initial follow-up visit and a DN4 questionnaire was filled out based on their current symptoms.

RESULTS: The early follow-up visit was performed at a mean of 3.0 months after surgery. 20 patients (27%) reported early LFCN symptoms, with the most common symptom being numbness. Only 5 patients (7%) had a DN4 score of ≥4 (mean 0.7/10, range 0-7). At a mean follow-up of 9.2 months after surgery, 18 of the 20 patients who had LFCN symptoms (90%) reported improvement with 10 patients (50%) reporting complete resolution of their symptoms. Lateral thigh numbness remained the most common complaint. At this later follow-up time, no patient had a DN4 score of ≥4 (mean 1.1/10, range 0-3). BMI, age, gender, and incision length were not associated with increased risk of LFCN symptoms.

CONCLUSION: 27% of DA THA patients reported early postoperative LFCN symptoms, with only 7% having neuropathic pain. At 9 months postoperatively, 90% of those patients who had initially reported LFCN symptoms reported improvement with half of these patients reporting complete resolution of their symptoms.

Chronic Rupture of the Gluteus Medius/Minimus and Its Significance in Total Hip Replacement Surgery

Abstract ID: Paper 146

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Many surgeons are switching from posterolateral or anterolateral hip approaches to the direct anterior (DAA) total hip surgery. Although there are advantages to DAA hip surgery, there are also drawbacks.

Femoral nerve trauma, skin issues, iatrogenic damage to the TFL, and fractures have all been reported. In addition, persistence of muscle weakness and gait disturbances have also been noted. One factor has not been discussed: postoperative abductor weakness.

A drawback of DAA exposure is the inability to observe the abductor musculature for chronic rupture. If chronic ruptures are left untreated, an unexplained postoperative limp may result.

210 consecutive primary THA performed by one surgeon were conducted looking prospectively for abductor rupture, either minimus or medius. If found, repair was carried out using an anterolateral exposure.

16% of patients were found to have chronic rupture of the gluteus medius or minimus.

Preoperative MRI scans were carried out in 12 patients. This was most often done to rule out AVN. Important MRI findings in the evaluation of gluteus medius and minimus ruptures will be discussed. Patients with high preoperative risk for abductor rupture will be identified.

CONCLUSIONS: A relatively high incidence of gluteus medius or minimus muscle ruptures were found in this series of patients. Repair of these muscle tears is appropriate and will be missed by surgeons doing the DAA hip approach.

Although DAA is a good approach to THA, it is not without its own issues and the surgeon should be well versed in posterolateral or anterolateral approaches that can fully address all of the pathology.

A Prospective Randomized Trial of Mini-Incision Posterior vs. Two-Incision Total Hip Arthroplasty: A Follow-Up Report at a Minimum of Five Years

Abstract ID: Paper 147

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INTRODUCTION: We previously described the early outcomes of a randomized trial of mini-posterior versus two-incision total hip arthroplasty and were unable to demonstrate clinical differences on early outcomes. As less invasive anterior approaches remain popular, the purpose of this report was to re-examine the outcomes, now at a minimum of five years postoperatively, to see if any differences could be demonstrated.

METHODS: 72 patients undergoing primary THA by a single surgeon were randomized to a mini-incision posterior or a two-incision approach. Complications, revisions, and clinical outcome measures were compared. Radiographs were reviewed for implant loosening. The original power analysis determined that 35 patients would be required in each arm of the study to detect a 20% difference in perioperative VAS pain scores and narcotic consumption.

RESULTS: At a mean of 8 years (range, 5–10 years), 6 patients had died without undergoing further surgery and 62 of 66 living patients were reviewed (31 per group). There were 3 revisions in the posterior group (one for recurrent instability and two for psoas impingement) and 2 revisions in the two-incision group (one for acetabular loosening, one for early periprosthetic fracture). For unrevised patients, there were no significant differences between groups (posterior vs. two-incision) in Harris Hip Score (94.7 ± 8.7 vs. 94.2 ± 10.0; p=0.834), SF12 physical (48.2 ± 9.5 vs. 49.0 ± 9.3; p=0.758), SF12 mental (54.6 ± 8.3 vs. 57.6 ± 4.2; p=0.084), or patient rating of the hip as a percentage of normal (97.7 ± 5.2% vs. 96.4 ± 5.7%; p=0.367).

CONCLUSION: With the sample size available for study, we found no differences in mid-term outcomes between the two approaches. Given the increased complexity, operative time, and need for fluoroscopy with the two-incision approach combined with equivalent early and mid-term outcomes, the two-incision approach has been abandoned in the senior author’s practice.

Surprisingly High Rate of Success of I and D With Component Retention for Acute Infection Following Hip Arthroplasty

Abstract ID: Paper 148

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INTRODUCTION: There are conflicting data, much historic, on results of irrigation and debridement (I&D) with component retention in patients with acute prosthetic hip infections.

METHODS: Ninety hips (57 total hip arthroplasties [THAs] and 33 hemiarthroplasties) were diagnosed with acute prosthetic hip infection (using strict criteria) and treated with I&D and component retention at one institution between 2000 and 2012. Mean follow-up: 6 years. Patients were stratified by MSIS host criteria. Persistent infection or reinfection was defined as implant removal for infection, active clinical infection, or persistent wound drainage.

RESULTS: Eventual component removal secondary to recurrent infection occurred in 10% (9/90). Component removal occurred in 6/66 (9%) after early postoperative infection and 3/24 (13%) after acute hematogenous infection (p=0.2). No components were removed in patients with MSIS host grade A, compared to 11% (p=0.03) in B and 33% in C hosts ($p < 0.01$). The rate of component removal in the THA group was 15% compared to 6% in the hemiarthroplasty group ($p = 0.43$). No implant removal was required for infection in 3 of 75 (96%) of those treated with chronic antibiotic suppression compared to 5 of 15 (33%) of those who were not suppressed (HR = 13; $p < 0.001$). No patients with implants still in place had evidence of active clinical infection.

CONCLUSINO: I&D with component retention was a surprisingly effective treatment for this group of patients with rigorously defined acute prosthetic hip infections treated with modern methods and in a timely manner. Systemic host grade A and use of chronic antibiotic suppression were predictive of treatment success.

Are Patients Being Evaluated for Periprosthetic Joint Infection Prior to Referral to a Tertiary Care Center?

Abstract ID: Paper 149

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BACKGROUND: Patients with a painful or failed total joint arthroplasty should be evaluated for periprosthetic joint infection (PJI). The purpose of this study was to determine if patients referred to a tertiary care center had been evaluated for PJI according to the AAOS clinical practice guidelines.

METHODS: 113 patients with painful hip (43) or knee (70) arthroplasties were referred to a single provider by orthopedic surgeons outside our practice between 2012 and 2014. We retrospectively evaluated the workup by referring physicians, including measurement of serum erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP), performance of a joint aspiration if these values were abnormal, and obtainment of synovial fluid white blood cell (WBC) count, differential, and cultures.

RESULTS: Sixty-two of the 113 patients (55%) did not have a workup that followed AAOS guidelines. Serum ESR and CRP were ordered for 64 of the 113 patients (57%). Of 25 patients with elevated inflammatory markers warranting aspiration, 15 (60%) had an aspiration attempted, with synovial fluid WBC, differential, and cultures obtained in 9 of 12 (75%) aspirations that yielded fluid. Of the 62 patients with an incomplete infection workup, 11 (18%) had a bone scan, 6 (10%) a CT scan, and 3 (5%) an MRI. Twelve of the 113 patients (11%) were ultimately diagnosed with PJI, with 5 undiagnosed prior to referral.

CONCLUSION: The AAOS guidelines to evaluate for PJI are frequently not being followed. Improving awareness of these guidelines may avoid unnecessary and costly evaluations and delay in the diagnosis of PJI.

Antibiotic Spacers for THR Infection: Hemiarthroplasty or Constrained Metal-on-Polyethylene?

Abstract ID: Paper 150

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INTRODUCTION: Articulating antibiotic-loaded cement spacers are widely used to treat periprosthetic joint infection. Despite wide acceptance, there is a paucity of evidence comparing different spacer designs. The purpose of this study was to compare the amount of bone loss and rate of mechanical complications with two different spacers.

METHODS: Sixty-four patients underwent treatment of an infected primary total hip arthroplasty with a two-stage revision using a hemiarthroplasty style spacer (31 cases) or a constrained metal on polyethylene (cMOP) style spacer (33 cases). Patient age, sex, dates of primary and revision surgeries, body mass index (BMI), and perioperative mechanical complications were obtained from their medical records. Each patient's femoral status was assessed according to the Paprosky classification. Component migration was measured from a series of 3 radiographic images using custom software. Bone loss was estimated by the increased size of the revision shell compared to the explanted primary shell.

RESULTS: There was no statistical difference in the two groups in terms of patient age, gender, and BMI. Patients in the hemiarthroplasty group were more likely to dislocate after stage 1 revision ($p<0.03$) when compared to those receiving cMOP. Independent of spacer treatment, there was a strong correlation between dislocation and obesity ($p<0.02$). There was no difference in the primary and revision cup diameters of the two groups (hemiarthroplasty: 3.52±3.28 mm; cMOP: 4.58±3.02 mm; $p<0.18$). However, there was a trend toward greater bone preservation after hemiarthroplasty, as expressed by the increase in shell diameter within 3 mm ($p<0.07$). Likewise, there was no difference in medial ($p<0.33$) or superior ($p<0.75$) cup migration.

CONCLUSION: Careful surgical technique and monitoring of hemiarthroplasty articulating spacers should be done to avoid dislocation during two-stage revision surgery. We found spacer dislocation was minimized using the cMOP design. Obese patients are high risk for dislocation and may be better suited for the cMOP design. We saw a trend toward acetabular bone preservation with the hemiarthroplasty design.

Metal Ion Levels in Young, Active Patients Receiving a Dual Mobility Total Hip Arthroplasty Prosthesis

Abstract ID: Paper 151

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INTRODUCTION: Dual mobility prostheses in primary total hip arthroplasty (THA) have increased in popularity due to their potential to improve component stability. The purpose of this study was to prospectively compare whole blood metal ion levels and clinical outcomes in young, active patients undergoing primary THA with the use of a dual mobility prosthesis versus a polyethylene acetabular liner.

METHODS: Patients less than 65 years of age, a body mass index of < 35 kg/m^2, and a pre-symptomatic UCLA activity score > 6 were included. Twenty-six patients received a dual mobility prosthesis with a cobalt alloy (n=10; 22 mm diameter) or ceramic (n=16; 28 mm) femoral head, highly cross-linked polyethylene articulation, and cobalt alloy acetabular liner. Seventeen patients received a cobalt-alloy (n=6; 32 mm), oxidized zirconium (n=5; 32 mm), or ceramic (n=6; 32mm) femoral head and highly cross-linked polyethylene acetabular liner ("conventional" cohort). All patients received a titanium, proximally coated, tapered cementless femoral stem and titanium, cementless acetabular component. Preoperative and postoperative SF-12 mental (MCS), SF-12 physical (PCS), and Harris Hip Scores (HHS) were collected. Chi-square and independent student's t-tests were used for comparisons between the dual mobility and conventional cohorts ($p<0.05$ = significant).

RESULTS: No difference was present for age or BMI between conventional and dual mobility cohorts. At one year postoperatively, there was an increase in the mean whole blood chromium (0.61 + 0.44 vs. 0.14 + 0.07, $p<0.001$) and titanium (1.70 + 0.71 vs. 1.00 + 0.26, $p<0.001$) levels in the conventional cohort.

In contrast, the mean cobalt level was 0.23 + 0.39 in the dual mobility cohort versus 0.15 + 0.07 in the conventional cohort ($p<0.001$). Four patients in the dual mobility cohort (2 ceramic and 2 cobalt alloy femoral heads) had a cobalt level outside of the reference range (0.03 to 0.29); outliers ranged from 0.34 to 1.8 ug/L. One patient in the conventional cohort had a cobalt level outside of the reference range with a value of 0.39 ug/L.

There was no significant difference between the two cohorts for preoperative or postoperative SF-12 MCS, SF-12 PCS, or HHS scores ($p=0.1$ to 0.9).

CONCLUSION: This investigation demonstrates minimal differences in mean whole blood metal ion levels at 1 year postoperatively with the use of a dual mobility versus conventional bearing surface in young, active patients undergoing THA. However, continued prospective evaluation of cobalt levels is warranted given the slightly increased number of reference outliers in the dual mobility cohort.

Serum Metal Levels for the Diagnosis of Adverse Local Tissue Reaction in Metal-on-Polyethylene Total Hip Arthroplasty

Abstract ID: Paper 152

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INTRODUCTION: Recently, corrosion at the head-neck junction in metal-on-polyethylene bearing total hip arthroplasty (THA) has been recognized as a cause of adverse local tissue reactions (ALTR). Serum metal levels have been advocated as a tool for the diagnosis of ALTR, however no prior studies have specifically examined their utility. The purpose of this study was to determine the optimal cutoff values for serum cobalt and chromium in diagnosing ALTR after metal-on-polyethylene bearing THA.

METHODS: We reviewed 447 consecutive patients with serum metal levels tested at our institution and identified 62 with a metal-on-polyethylene bearing who had axial imaging or underwent reoperation to confirm the presence or absence of ALTR. Receiver operating characteristic curves were produced to identify cutoff thresholds to optimize sensitivity and diagnostic test performance was characterized.

RESULTS: 42 of the 62 patients (66%) were positive for an ALTR. The best test for the diagnosis of ALTR was the serum cobalt level (area under the curve [AUC]=99%). A threshold cutoff of ≥ 1.0 ng/ml had a sensitivity of 100%, specificity of 90%, positive predictive value (PPV) of 96%, and negative predictive value (NPV) of 100%. Serum chromium levels were also diagnostic (AUC=87%). A threshold cutoff of ≥ 0.15 ng/ml had a sensitivity of 100%, specificity of 50%, PPV of 81%, and NPV of 100%. Finally, serum cobalt to chromium ratio was also helpful for diagnosis (AUC=90%). A threshold cutoff of 1.4 for the cobalt to chromium ratio offered a sensitivity of 93%, specificity of 70%, PPV of 87%, and NPV of 82%.

CONCLUSIONS: Measurement of serum cobalt with a threshold value of 1.0 ng/ml in our experience is the best test for identifying the presence of ALTR in patients with a metal-on-polyethylene THA. Measurement of chromium and the ratio of cobalt to chromium are also of value.

The Utility of Metal Ion Trends in Predicting Revision in Metal-on-Metal THA

Abstract ID: Paper 153

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INTRODUCTION: There is a paucity of published data examining serum metal ion level trends over time. The utility of this data in guiding treatment decisions following metal-on-metal (MoM) total hip arthroplasty is unknown. The goal of this study was to examine the clinical value of metal ion trends over time in guiding surgical intervention for failed MoM total hip arthroplasty (THA).

METHODS: We retrospectively reviewed 64 patients (74 hips) who underwent THA with the ASRTM system. We assessed revision rates. We reviewed pre-revision cobalt (Co) and chromium (Cr) concentrations over time as well as ultrasound and MRI findings. At the time of revision surgery, local soft tissue destruction was assessed by the primary surgeon and reported as severe if the abductors, external rotators, or posterior joint capsule were involved. Minimum follow-up was 2.2 years (mean, 5.9 years; range, 2.2-9.1 years). Four patients (4 hips) were lost to follow-up.

RESULTS: The overall revision rate was 35.7% (25/70). Multivariate regression analysis showed that the development of pain was associated with a significantly elevated risk of revision (OR= 45, $p<0.0001$). Patients who underwent a revision surgery had significantly elevated Co levels during the first 3 years following their initial surgery (Co 7.3 vs. 3.1 ng/mL: $p=0.016$). Patients diagnosed with a pseudotumor had significantly elevated Co and Cr levels during the first 3 years following their initial surgery (Co 8.0 vs 4.2 ng/mL: $p=0.017$, Cr 6.6 vs 1.9 ng/mL: $p=0.0034$). At the time of revision surgery, severe local soft tissue destruction was seen in 67% of patients who had pain as well as elevated Co levels during the first 3 years following their initial surgery compared to 0% of patients who did not have pain or elevated Co levels during this time period ($p=0.001$).

DISCUSSION/CONCLUSION: In our experience, pain is a significant predictor of revision surgery. Patients who experienced pain and had elevated Co levels during the first three years following their initial surgery showed a significantly higher percentage of severe local tissue destruction at the time of revision surgery. Based on this relationship, revision surgery should be discussed and likely recommended in patients with painful implants and persistently elevated Co levels especially if these were present within 3 years of surgery.

Alpha-Defensin Test for Diagnosis of PJI in the Setting of Failed Metal-on-Metal Bearings or Corrosion

Abstract ID: Paper 154

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PURPOSE: Metal-on-metal (MoM) bearing surfaces pose a unique challenge in that some patients may develop adverse local tissue reactions (ALTR) that can mimic periprosthetic joint infections (PJI). Alpha-defensin has emerged as a reliable test for diagnosis of PJI, with many clinicians incorporating it into their diagnostic algorithm. The purpose of this multi-center study was to evaluate the performance of the alpha-defensin test in patients with failed MoM bearing surfaces or an ALTR secondary to corrosion.

METHODS: Following IRB approval, we reviewed 26 patients from three institutions with a failed MOM hip or a corrosion reaction that had an alpha-defensin test performed. Fifteen patients had a MoM total hip arthroplasty, 10 ALTR secondary to head-neck corrosion, and 1 MoM hip resurfacing.

RESULTS: One of the 26 patients met Musculoskeletal Infection Society (MSIS) criteria for infection. However, 8 of 26 (31%) had a false-positive (FP) alpha-defensin test, while 17 of 26 (65%) were true-negatives (TN) and 1 of 26 (4%) was true-positive, corresponding to a negative predictive value (NPV) of 100%, and a positive predictive value (PPV) of 11%. The specificity was 68% and sensitivity was 100%. The subjects with a false-positive had significantly higher synovial white blood cell (WBC) counts (2,683 vs. 649 WBC/uL, p=0.024), with a trend towards higher serum ESR (17.1 vs. 8.8 mm/hr, p=0.053) and CRP levels (17.9 vs. 10.4 mg/L , p=0.25). Serum metal levels were similar between false-positives and true negatives (Cobalt 14.7 vs. 15.7 µg/L, p=0.92; Chromium 11.3 vs. 9.4 µg/L, p=0.79). A higher proportion of the subjects who tested false-positive had head-neck corrosion (FP 50%, TN 29%, p=0.39); however, this was not significant with the numbers available.

CONCLUSION: The alpha-defensin test for PJI has a high negative predictive value in the setting of a ALTR. However, not unlike the synovial fluid WBC count, it is prone to falsely positive results.

MAOA BREAKOUT SESSION #12
PEDIATRICS/SPINE
April 122, 2017

Pediatric Proximal Both-Bone Forearm Fractures: Factors Predicting Outcome

Abstract ID: Paper 155

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INTRODUCTION: The literature is replete with outcomes studies on pediatric forearm fractures; however, information concerning the outcomes of both-bone fractures of the proximal radius and ulna is limited. The purpose of our study was to evaluate the prognosis and outcomes in children with combined fractures of the proximal radius and ulna, with special attention to complications.

METHODS: A single-center, retrospective study identified patients aged 3 to 15 years old with proximal forearm fractures treated between January of 1994 and February of 2014. Patients were excluded if they did not have both-bone fractures of the proximal forearm. Records were reviewed with a focus on outcomes and their association with age at the time of injury, severity of injury, type of treatment, and complications.

RESULTS: Thirty-one patients met inclusion criteria. Significant differences were seen between patients younger than 10 years of age and patients 10 years of age or older in rates of requiring operative treatment ($p=0.048$) and returning to the operating room ($p=0.037$). There was no significant difference in nerve injury ($p=0.519$) or range-of-motion deficits ($p=0.872$) based on age. In addition, no difference was seen in range-of-motion deficits based on severity of injury as determined by displacement (complete or none) ($p=0.139$).

CONCLUSIONS: Most proximal both-bone forearm fractures in children, including olecranon and radial neck fractures, Monteggia type IV fractures, and nonspecific proximal both-bone forearm fractures, have good-to-excellent results. In our study, older age, defined as 10 years of age or older at the time of injury, resulted in more frequent need for operative intervention, a higher rate of return to the OR, and greater risk of nerve injury. The older children were not more likely to have range of motion deficits despite a more involved course, which contradicts previous reports, and older age at the time of injury did not necessarily predict poorer outcomes.

The Utility of Routine Postoperative Radiographs After Pinning of Pediatric Supracondylar Humerus Fractures

Abstract ID: Paper 156

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BACKGROUND: The purpose of this study was to determine the frequency with which postoperative radiographs resulted in a change in management following closed reduction and percutaneous pinning of displaced pediatric supracondylar humerus fractures. We hypothesize that only the initial postoperative radiograph will lead to changes in management of operative supracondylar humerus fractures.

METHODS: A retrospective review was performed at two level 1 pediatric trauma centers. Inclusion criteria were patients less than 18 years of age who sustained supracondylar humerus fractures (Gartland type II, III, IV) who were operatively-treated from 2008 to 2013 with adequate radiographic follow-up. Patients with flexion type, intra-articular, transphyseal and open fractures were excluded from the study.

RESULTS: 842 patients were identified, of whom 269 were excluded. The final analysis included 574 patients. Six (1.0%) underwent revision surgery based on initial postoperative follow-up imaging, while one (0.1%) patient had a pin adjustment and two (0.3%) had a single pin removed in the clinic. No decisions for revision surgery were made based on imaging obtained after the initial follow-up visit. At the time of pin removal, 20 (4.8% of 419) patients required further immobilization based on imaging that suggested incomplete healing. No decisions for revision surgery were made based on imaging at pin removal.

CONCLUSIONS: Routine postoperative radiographs following closed reduction and percutaneous pinning of displaced pediatric supracondylar humerus fractures did not alter clinical decision-making. No radiographs after initial follow-up resulted in revision surgery or significant changes in clinical management. This identifies a potential area where radiographs and resource utilization can be reduced without compromising the quality of care. The findings suggest that radiographs should be obtained within 7-10 days postoperatively for type III fractures and need not be done again unless the clinical situation warrants it. Routine radiographs at other time periods were shown to have no significant utility in the management of supracondylar humerus fractures.

Differentiating Septic Arthritis from Transient Synovitis in a Rural Tertiary Care Center

Abstract ID: Paper 157

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PURPOSE: Differentiating septic arthritis from transient synovitis continues to be a challenge. Previous studies determined that erythrocyte sedimentation rate, white blood cell count, history of fever, non-weight-bearing status, and a later-studied C-reactive protein can help distinguish these two entities. These studies were carried out in urban centers (Boston and Philadelphia), while a population from St. Louis yielded questionable results for the initial four criteria. It is unclear if these criteria can be applied to a more rural population. The purpose of this study was to assess the capabilities of these criteria to differentiate septic arthritis from transient synovitis in a rural tertiary care center. Our hypothesis was that the criteria used previously to distinguish septic arthritis from transient synovitis at larger urban centers would exhibit similar diagnostic capabilities.

METHODS: Patients treated from 2000-2014 were identified retrospectively. Septic arthritis patients were defined as those who had positive joint aspirate cultures, a joint aspirate cell count greater than 50,000, or positive blood cultures. Transient synovitis patients were defined as those that had acute atraumatic onset of hip or knee pain, had received no antibiotics, were treated to complete resolution with non-steroidal anti-inflammatories, and had no subsequent or prior history of rheumatologic or neoplastic conditions. Thirty septic arthritis patients and 32 transient synovitis patients were identified. Data regarding fever (>38.5°C), ESR (>40 mm/h), CRP (>2.0 mg/dl), WBC (>12,000 cells/µl), and weight-bearing status were retrieved from the medical record and used to determine the correct classification rate (CCR) for differentiating septic arthritis from transient synovitis using the 4 or 5 criteria. Fisher's Exact tests were used to analyze for significant differences ($p<0.05$) in proportions and odds ratios were calculated when differences were statistically significant.

RESULTS: When patients had 3/5 criteria for septic arthritis, the CCR was 84% and these patients were significantly ($p<0.001$) and 27 times more likely to have septic arthritis than transient synovitis. Patients with 4/5 criteria were 105 times more likely to have septic arthritis than transient synovitis ($p<0.001$). Patients with 5/5 criteria were significantly ($p<0.001$) and infinitely more likely to have septic arthritis than transient synovitis.

CONCLUSION: Patients presenting with 3 or more of the 5 criteria previously determined to be diagnostic for septic arthritis in urban centers are significantly more likely to have septic arthritis than transient synovitis.

SIGNIFICANCE: This study confirms that previously described criteria for diagnosing septic arthritis in urban centers can be applied to rural settings.

What About the Children? Incidence of Radial Nerve Palsy in Pediatric Humeral Shaft Fractures

Abstract ID: Paper 158

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INTRODUCTION: Humeral shaft fractures complicated by radial nerve palsy continue to be an important injury in the adult population with an average incidence of 11.8%; debate is ongoing regarding their optimal management. In the pediatric population, humeral shaft fractures are less common and little information exists regarding the incidence or management of radial nerve palsy in pediatric humeral shaft fractures. This study aims to evaluate incidence and outcomes of radial nerve palsy in pediatric humeral shaft fractures.

METHODS: IRB-approved retrospective study reviewed pediatric patients treated for humeral shaft fracture between 1996-2016. At latest follow-up data including fracture characteristics, operative vs. nonoperative management, complications, and outcomes were recorded.

RESULTS: The series includes 100 patients (32 female, 68 male) with average age at injury of 10 (range 0-17). Average follow-up was 34 months (range 2-181) excluding 7 patients deceased from inciting trauma. Fractures in this series were 65 type AO 12A, 13 type 12B, and 2 type 12C. Location included proximal (6), middle (72), middle/distal junction (6) and distal third (16). Final fracture treatment consisted of nonoperative (70 patients) and operative (30) management.

Overall, any nerve injury was noted in 8/100 patients including radial (5), ulnar (1), median (1) and mixed radial, ulnar, and median nerve symptoms (1) giving an overall incidence of radial nerve palsy of 6%.

Nerve injury was noted in fractures only in the middle, middle/distal, or distal location with no injuries in the proximal third. Nerve recovery was noted in 8/8 patients at an average time to full recovery of 133 days (range 2-378). Average time to onset of recovery was 47 days (range 0.25-145). Median and ulnar nerve palsies showed earlier recovery with average onset of recovery 1 day (range 0.25-2) and average full recovery 3 days (range 2-4).

DISCUSSION AND CONCLUSION: This study is significant as it is the first to define the incidence (6%) and outcomes (full recovery in all) of radial nerve palsy in pediatric humeral shaft fractures.

Buckling Down on Torus Fractures: Has Evolving Evidence Affected our Practice?

Abstract ID: Paper 159

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INTRODUCTION: Traditionally, pediatric torus fractures of the wrist have been managed with cast immobilization and regularly scheduled radiographic and clinical examinations. However, high-quality evidence has emerged supporting a 'minimalist' approach to these injuries with splint immobilization and limited clinical or radiographic follow-up. The present study sought to evaluate the management of these injuries in current practice. We hypothesized that aspects of 'traditional' management remain common despite the evidence base.

METHODS: A retrospective chart review was performed of a consecutive series of patients with torus fractures of the wrist managed at a single institution between May 2011 and November 2014. Patients lacking diagnostic consistency, documentation of external management, incorrect coding, or concomitant injuries impacting treatment were excluded. Records were reviewed to determine location of presentation, use of radiographs, type of prescribed immobilization (cast vs. splint), duration of immobilization, and complications occurring during treatment. The encounter time for all visits occurring at our institution was also calculated. Patients casted (CAST) for any portion of their treatment were compared with those managed with only a splint (SPLINT).

RESULTS: Two hundred and forty torus fractures of the wrist occurring in 236 patients met inclusion criteria. Seventy (29.1%) injuries were referred in after initial management at an outside facility. Twenty-five (10.4%) were lost to follow-up after treatment at our center. Age at injury was 7.5 +/- 3.5 years old with 123 (51.3%) fractures occurring in males. Providers utilized a cast during the management of 224 (93.3%) of the injuries. Of those completing care at our institution, SPLINT patients had fewer clinical visits (2.3 vs. 3.0, $p<0.01$), fewer radiographic examinations (1.9 vs. 2.4, $p<0.05$) and a shorter total encounter time (3.5 vs. 5 hours, $p<0.01$) than CAST patients. Twenty-one cast-related problems (e.g. wet cast) occurred requiring an unscheduled clinic visit for cast change. No clinically significant displacement or completed fractures occurred in patients returning for follow-up in either group.

CONCLUSION: Cast utilization and frequent radiographic follow-up remain common at our institution in the management of pediatric torus fractures despite growing evidence supporting alternative strategies. Cast-related complications requiring unscheduled clinical encounters are not uncommon. Splint-only management of torus fractures of the wrist at our institution is associated with fewer clinical visits, fewer radiographic examinations, and a shorter total encounter time. Based on these findings, future studies are in progress to explore barriers to utilization of the 'minimalist' approach despite apparent benefits to the patient, caregiver, and provider.

Any Cortical Bridging Predicts Healing of Supracondylar Femur Fractures

Abstract ID: Paper 160

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PURPOSE: Locking plates are frequently used for fixation of supracondylar femur fractures, particularly in the setting of osteoporosis. This treatment has been increasingly associated with reports of deficient callus, nonunion, and need for secondary procedures with bone grafting. Outside of implant failure, there is no consensus regarding the radiographic and clinical criteria used to assess fracture healing. Ideally, a discriminating tool could accurately identify fractures bound for union versus nonunion based on information available in the first few months after injury. The aim of this study is to determine the accuracy and reliability of radiographic cortical bridging criteria in predicting the final healing of supracondylar femur fractures.

METHODS: We retrospectively reviewed the records at two level 1 trauma centers for patients who presented with supracondylar femur fractures (AO/OTA 33A, C) and were treated with locking plate fixation between 1/1/2004 and 1/1/2011. The final study population included 82 fractures after excluding patients with open physes (n=4), nondisplaced fractures (n=4), early revision for technical failure (n=4), or inadequate follow-up (n=42). Postoperative radiographs until final follow-up were assessed for cortical bridging at each cortex on anterior-posterior (AP) and lateral views. Analysis by three orthopedic traumatologists allowed assessment of reliability. Final determination of union required both radiographic and clinical confirmation. Receiver operator characteristic (ROC) curve and chi square analyses were performed to determine the predictive accuracy of each criterion throughout the postoperative period.

RESULTS: Assessment for any cortical bridging the earliest, highly accurate predictor of final bony union (95.1% accuracy at four months postoperatively), then criteria requiring bicortical bridging (93.9% accuracy at 6 months), and tricortical bridging (78% accuracy at 21 months). Any cortical bridging demonstrated a higher interobserver reliability (kappa=0.73) relative to bicortical (kappa=0.27) or tricortical bridging (kappa=0.5).

CONCLUSIONS: Our results for plate fixation of supracondylar distal femur fractures mirrors those previously described for tibia shaft fractures following intramedullary nailing. Any radiographic cortical bridging by four months postoperatively is an accurate and reliable predictor of final healing outcome following locking plate fixation of supracondylar femur fractures. Assessment for bicortical or tricortical bridging is less reliable and inaccurate during the first postoperative year.

Effect of NSAID Use in the Acute Phase of Skeletally Immature Bone Healing: A Prospective, Randomized, Blinded, Controlled Trial

Abstract ID: Paper 161

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INTRODUCTION: Non-steroidal anti-inflammatory drugs (NSAIDs) are effective in controlling pain associated with orthopedic injuries and treatment, particularly in the pediatric population, and can minimize the need for narcotic pain medications. There are little data regarding the effects these medications have on long bone fracture healing in skeletally immature patients.

METHODS: In this prospective, randomized controlled study, skeletally immature patients with a long bone fracture were randomized to one of two groups for their post-fracture pain management: one group received acetaminophen (Control Group) and the other received ibuprofen (NSAID group). Both groups received oxycodone for breakthrough pain. The patients were followed clinically for fracture healing and were evaluated with physical examination, visual analog pain score, and radiographs.

RESULTS: Eighty-one skeletally immature patients with long bone fractures were enrolled. Three were lost to follow-up. Seventy-eight completed 6 months of follow-up (45 in the Control group and 33 in the NSAID group). The groups were similar in regards to age, gender, height, weight, and BMI. None of the patients achieved healing by the 1-2 week follow-up. By six weeks, 74% of the Control patients had healed fractures and 89% of the NSAID patients had healed fractures ($p = 0.1$). At the 10-12 week follow-up, 97% of the Control group fractures were healed and 100% of the NSAID group fractures were healed. All fractures were healed in both groups by 6 months. Healing was documented at a mean of 44 days in the Control group and 42 days in the NSAID group ($p = 0.58$; power = 0.8). The mean number of days breakthrough oxycodone was used was 2.5 days in the Control group and 2 days in the NSAID group. No statistically significant differences in pain scores were found between groups at any time point.

DISCUSSION AND CONCLUSION: The results of this study provide evidence that NSAID use in the acute phase of fracture healing does not impair long bone fracture healing in skeletally immature patients and can be a useful alternative for pain control in the acute fracture setting.

ACGME Resident Case Logs - Are Splint Application and Fusion for Spine Deformity Equivalent?

Abstract ID: Paper 162

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PURPOSE: Orthopedic surgery residents in the United States are required to report all surgical cases performed during their training to the Accreditation Council for Graduate Medical Education (ACGME). Previous studies using the annual ACGME resident surgical case log data reports have revealed significant variability in total cases, and especially pediatric cases, logged per graduating resident. Case logs quantified by absolute total cases suggest that a spine fusion is equivocal to a cast application. Case logging practices are also known to differ greatly between residents. We hypothesize that there is less variability in pediatric operative case volume when quantified using work Relative Value Units (wRVU) compared to the absolute number of cases logged.

METHODS: ACGME surgical case logs from the previous 10 years of graduating residents of a single, accredited orthopedic surgery residency were analyzed using a de-identified database including only pediatric cases. Work RVUs were assigned to each CPT code logged based on the Centers for Medicare & Medicaid Services National Physician Fee Schedule Relative Value File Calender Year 2016 Database. If multiple procedures were listed for the same case, the procedures were ranked by fee schedule amount and reduced appropriately (e.g., 1, 2, 3, 4…100%, 50%, 25%, 25%). Case logs quantified by wRVU per case were compared to case logs quantified by number of CPT codes.

RESULTS: The average total number of pediatric cases logged per graduating resident was 223.4, with a range of 107-419 and standard deviation (STD) of 71.1. The average total number of wRVUs for all pediatric cases logged per graduating resident was 2365.5, with a range of 1096.3-4612.7 and STD of 968.1. Residents at or above the 75th percentile for number of cases logged on average had a lower average wRVU per case compared to the 25th percentile and below (7.4 vs 8.2, p=0.05). When cases with wRVU values below 4.0 were removed from case logs, there was greater change in case log percentile rankings quantified by absolute case numbers rather than wRVUs (6.2% vs. 2.5%, p=<0.001).

DISCUSSION: Although there are many factors involved in surgical training experience, ACGME case logs which quantify each procedure equally do not accurately reflect pediatric surgical case experience of orthopedic surgery residents. Work RVUs, which account for the time, complexity, and risk associated with a procedure, can offer a better assessment of resident training experience and provide a better understanding of the large variability in the absolute pediatric case numbers logged by orthopedic residents.

Optimizing the Vertical Position of the Brace Thoracic Pad: Apical Rib or Apical Vertebra?

Abstract ID: Paper 163

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INTRODUCTION: The vertical position of the thoracic pad has been a subject of controversy in brace design. Traditional recommendations dictate a maximal force applied at the level of the apical rib, usually about 2 levels below the apical vertebra. Fulcrum bending radiographs constitute an appropriate tool to simulate a passive lateral pressure force applied inside a brace. We thus sought to evaluate the optimal vertical position of the brace thoracic pad using fulcrum bending radiographs.

METHODS: In this prospective study, we recruited patients presenting to our scoliosis clinic over a period of 12 months. Inclusion criteria comprised: diagnosis of adolescent idiopathic scoliosis (AIS), age 10 years or older, Risser stage 0-2, and a thoracic curve with a Cobb angle of 20˚-50˚. Exclusion criteria included history of spine or thoracic surgery. In addition to standard scoliosis radiographs, 2 fulcrum-bending radiographs were performed for each patient: one with the center of the fulcrum placed under the most lateral part of the apical rib and another with the fulcrum centered below the apical vertebra. Cobb angles were measured on each fulcrum radiograph and compared using a paired t test. Pearson's r and Spearman's rho were used for correlation analysis between curve reduction and patient age and apical level, respectively.

RESULTS: Fifty-two patients (41 female and 11 male) verified the inclusion criteria and consented to participate in the study. The mean age was 12.4 +/- 1.4 years and the mean thoracic Cobb angle was 37.5˚ +/- 11.0˚. Placing a fulcrum under the apical vertebra reduced the Cobb angle to a mean of 11.5˚, which was significantly lower than a fulcrum placed under the apical rib (14.3˚, p=0.001). This corresponds to a 20% loss in correction when placing the fulcrum under the apical rib. The difference between the 2 Cobb angles was not significantly correlated to patient age (p=0.896) or curve apex (p=0.555).

DISCUSSION AND CONCLUSIONS: This is the first clinical study that addresses the vertical position of the thoracic pad in braces for AIS. A lateral force applied at the level of the apical vertebra was significantly more efficient at reducing thoracic curve deformities than a force applied at the apical rib. Our results provide clinical support to finite element studies that refute traditional recommendations of brace design, advocating for a revision of these guidelines to optimize non-operative treatment of AIS.

Distal Junctional Failure Following Pediatric Spinal Fusion

Abstract ID: Paper 164

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BACKGROUND: Adjacent segment pathology is a known complication after spinal fusion, but little has been reported on acute junctional failure. A series of adolescent patients presented with acute distal junctional failure following fusion. We sought to determine any common features of these patients in order to develop a prevention strategy.

METHODS: A retrospective review was conducted of pediatric patients who developed acute distal junctional failure after instrumented spinal fusion performed at two institutions from 1999-2013. Patients with proximal junctional failure or junctional kyphosis without failure were excluded.

RESULTS: Fifteen subjects were identified with mean follow-up of 38 months. Distal failure occurred a mean of 60 days after index surgery, with history of minor trauma in four patients. Failures included 3-column Chance fracture (11) or instrumentation failure (4). Thirteen patients presented with back pain and/or acute kyphosis, while two asymptomatic patients presented with healed fractures. Two patients developed new onset of severe lower extremity neurologic deficit after fracture, which improved but never resolved after revision. 13/15 subjects required revision surgery, typically within one week. Complications associated with revision surgery were encountered in 8 patients (62%). Major complications that required subsequent return to the operating room included two deep infections, two instrumentation failures, and dense lower extremity paralysis that improved after medial screw revision and decompression. At final follow-up, 10 patients are asymptomatic, two have persistent neurologic deficit, two have chronic pain, and one has altered gait with gait aid requirement.

CONCLUSION: This heterogeneous cohort of spinal fusion patients developed distal junctional failure from 3-column Chance fracture or instrumentation failure. Revision surgery is typically required, but has a high complication rate and can result in severe neurologic deficit, highlighting the morbidity of this complication. It is unclear whether level of the lowest instrumented vertebra contributes to distal junctional failure. As a result of this study, the surgeons who previously did not tap pedicles prior to screw placement now do so. We have discontinued aggressive decortication at the LIV to avoid structural weakening. Consideration is given to postoperative bracing for patients with large preoperative kyphosis or intraoperative sagittal deformity correction. Increased awareness of junctional failure in children may prompt additional studies to further characterize risk factors and preventative strategies.

The Effects of Single-Level Anterior Cervical Discectomy and Fusion (ACDF) on Diabetes and Depression

Abstract ID: Paper 165

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BACKGROUND: The purpose of the present study was to determine the differences in health outcomes, between patients with cervical spondylosis who underwent single level anterior cervical discectomy and fusion (ACDF) versus patients with cervical spondylosis who did not receive an ACDF fusion (Non-ACDF). The hypothesis of the study was that patients receiving single level fusion have a lower risk of downstream cardiovascular disease and depression.

METHODS: The Medicare 5% sample was used to identify patients diagnosed with spondylosis during 2005–2012. All spondylosis patients were separated into non-arthroplasty and arthroplasty groups. Differences in new disease diagnoses, age, sex, and Charlson Comorbidity Index (CCI) scores were recorded.

RESULTS: The RR of heart failure was lower in the ACDF group after 3 (RR = 0.6719; $p < 0.05$), 5 (RR = 0.8477 p = 1.17), and 7 (RR = 0.7709; p = 1.625). The RR of depression was higher in the ACDF group at 1 (RR = 2.5008), 3 (RR = 1.4473), 5 (RR = 2.2625), and 7 (RR = 2.2257) years ($p < 0.05$ for all). Mean CCI scores of patients before undergoing ACDF was 10 (SD 9.20), while the mean after surgery was 8 (SD 7.84; $p < 0.05$) and remained unchanged for Non-ACDF patients at a CCI of 10 (SD 9.00; $p < 0.05$).

CONCLUSIONS: The results demonstrate the patients in the ACDF cohort have increased RR of depression, but a decreased risk of cardiovascular disease. Further research may be needed to delineate why the ACDF procedure potentially benefits a patient for heart disease, but may stress a patient's social/economic supports during the recovery process thus leading to higher depression rates for patients undergoing ACDF.

Safety of Sublaminar Polyester Bands Utilized in Spinal Deformity Correction

Abstract ID: Paper 166

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SUMMARY: The posteromedial translational corrections and fusion using new hybrid instrumentation with sublaminar polyester bands (SB) and pedicle screws has proven to achieve excellent curve correction, not only in the coronal plane, but also in restoration of sagittal alignment and rotational correction. Their safety profile is not widely described in the literature. We conclude that sublaminar polyester bands are just as safe as other instrumentation techniques.

HYPOTHESIS: The safety of sublaminar polyester bands in the new hybrid instrumentation technique for the correction of pediatric spinal deformities is as safe as other instrumentation techniques.

DESIGN: A retrospective study.

INTRODUCTION: The posteromedial translational corrections and fusion using new hybrid instrumentation with sublaminar polyester bands (SB) and pedicle screws has proven to achieve excellent curve correction, not only in the coronal plane, but also in restoration of sagittal alignment and rotational correction. Their safety profile is not widely described in the literature.

METHODS: There were 151 spinal deformity pediatric patients treated using a hybrid instrumentation technique. This hybrid technique consisted of pedicle screws, transverse process hooks, as well as at least one SB. Every surgery was performed with intraoperative hemodynamic analysis and neurophysiologic monitoring. We monitored somatosensory evoked potentials (SSEP), motor evoked potentials (MEP), electromyography (EMG), and their times to return to normal once found abnormal. An alert was recorded at any decrease in amplitude, increase in latency, abnormal EMGs, and the time to normalize.

RESULTS: We used 939 SB in 151 spinal deformity correction patients over a period of 2008 to 2015. There were 9 (<0.01%) EMG, 0 SSEP, and 0 MEP alerts during the passage of the SB under the lamina in a single surgeon specific technique. In 3 cases, 8 SBs associated with alerts were removed. More neurophysiologic alerts were associated with the spinal correction maneuver than seen with any of the hardware placed. There was no significant difference when comparing neurophysiologic alerts with age or the severity of the deformation. In our data, we also found that we had a similar proportion of neurophysiologic alerts with the placement of pedicle screws.

CONCLUSION: The safety of sublaminar polyester bands in our review of spinal deformity correction patients was found to be similar to other implants used in the correction of spinal deformities. We conclude that the utilization of a new hybrid technique with sublaminar polyester bands is a safe alternative to previous described techniques.

Osteopenia Screening Utilizing a Novel CT Based DEXA Equivalent Algorithm

Abstract ID: Paper 167

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Vertebral compression fractures (VCF) are the most common type of osteoporotic fracture. In the USA, costs attributable to VCFs alone have been appraised at $1.07 billion with indirect costs due to patients and caregiver loss of productivity at $6 billion annually. Despite its prevalence, diagnostic testing for osteoporosis such as the DEXA scan is not routine. Fewer than 50% of eligible Medicare recipients undergo bone mineral density screening. In contrast, CT scanning for other conditions is readily utilized, with over 80 million scans performed annually in the USA. At the authors institution, a computerized CT based algorithm has been introduced as a novel analytic program to be utilized as a mass osteoporosis screening tool.

Patients with CT studies of the chest, abdomen and lumbar spine and corresponding DEXA scans performed within 12 months of one another were evaluated. An independent reviewer was blinded to DEXA scores of patients. Outcomes measured were DEXA derived T-Score and CT Based Algorithm derived T-Score. Association between patient DEXA and CT based T-Scores were analyzed by a paired T-Test and Chi Square test via intraclass correlation coefficient data.

There were 157 patients scores derived from CT and DEXA based data. In the CT group, 37 patients were identified as osteoporotic (T-Score < -2.5), 76 osteopenic (T-Score < -1 to -2.5), and 59 normal (T-Score > -1.0). In the DEXA group, 25 identified as osteoporotic, 48 osteopenic, and 84 normal. Paired t-test revealed that there was a significant association between screening types ($p < 0.001$). The Intraclass Correlation Coefficient was 0.55 with a confidence interval of (0.43, 0.65). 73 patients were flagged as being osteopenic via DEXA, while 113 patients via CT. 68 patients collectively identified as osteopenic using both screening methods. The CT based screening method showed a sensitivity of 0.93, and a specificity of 0.46.

This retrospective review identified the association between DEXA and CT based screening methods for osteopenia. The CT based algorithm proved to be highly sensitive for the detection of osteoporosis, accurately deriving a T-Score utilizing CT volumetric information of both trabecular and cortical bone of the lumbar vertebrae. This CT based screening tool offers compelling advantages. It provides a cost effective, mass screening tool for osteoporosis, and has broad future applications, such as identifying patients at risk for vertebral compression fractures.

Effects of Caffeine on Intervertebral Disc Cell Viability in a Whole Organ Culture Model

Abstract ID: Paper 168

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INTRODUCTION: Symptomatic intervertebral disc (IVD) disorders are extremely prevalent, yet mechanisms of IVD degeneration are not fully understood. Environmental factors are suspected contributors. Previous studies demonstrate decreased cell viability and glycosaminoglycan (GAG) content in injured rat tail IVDs after nicotine exposure in a whole organ culture model. Although structurally different, nicotine and caffeine share a number of physiologic effects. While caffeine has been implicated as a contributor to back pain, its effects on IVD pathology are unclear. Given the large number of individuals consuming caffeine, it is important that we further investigate the role of caffeine in IVD disorders.

METHODS: Following ACUC approval, tails were collected from skeletally mature rats (n=7) euthanatized for reasons unrelated to this study. Explants consisting of cranial body half, endplate, IVD, endplate, and caudal body half were harvested (n=72). IVD explants were randomly assigned to one of three groups: low caffeine (n=24) (5 mg/L), medium caffeine (n=24) (10 mg/L), and high caffeine (n=24) (15 mg/L) (avg. serum concentrations of coffee drinker 2-10 mg/L, abuse >15 mg/L). All explants were cultured and harvested on days 7, 14, and 21. Cell viability was subjectively assessed in each IVD using fluorescent microscopy and cell viability stains. GAG stability was determined based on a DMMB assay. Collagen content was determined using the hydroxyproline assay. Data were compared for differences among groups with significance set at $p<0.05$.

RESULTS: Cell viability analysis demonstrated significantly higher cell viability in the low caffeine group (629 cells/mm^2) compared to the high caffeine group (380 cells/mm^2) at day 7 ($p=0.037$) and in the low caffeine group (527 cells/mm^2) compared to the medium (372 cells/mm^2) and high caffeine groups (322 cells/mm^2) at day 21 ($p\leq0.004$). Biochemical analyses demonstrated a temporal, downward trend in proteoglycan to collagen ratio for the low caffeine group. By day 21, the low caffeine group regressed to similar levels compared to the medium and high caffeine groups.

CONCLUSIONS: In this model, caffeine exposure was associated with an inverse, dose-dependent relationship where IVD cell viability decreased as caffeine concentration increased. Decreasing proteoglycan-to-collagen ratio in the low-caffeine group may suggest a detrimental effect of caffeine on biochemical composition of IVD extracellular matrix. Importantly, low caffeine levels were associated with potentially detrimental matrix effects and higher caffeine levels showed rapid changes in IVD tissue composition in this model. Ongoing research in our laboratory is focused on assessing the impact of caffeine on injured IVDs.

The Use of a Novel iPad Application to Quantify Dysfunction in Cervical Myelopathy Patients

Abstract ID: Paper 170

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INTRODUCTION: Cervical myelopathy is the leading cause of spinal cord dysfunction in the adult population. Despite the prevalence and importance of the condition, there is a paucity of objective and quantitative clinical measures for analysis of the disease process. The lack of an easily-performed, objective, and quantitative diagnostic tool has hindered the diagnosis of these patients. In an effort to better classify myelopathy, provide earlier diagnosis, and improve clinical outcome measurements we developed a novel iPad application to test fine motor skills. A decline in these fine motor skills is an early hallmark of cervical myelopathy.

METHODS: We recruited 71 healthy control patients and 12 myelopathic patients aged of at least 18 years and no neurologic or physical condition that precluded fine motor testing. Myelopathic subjects were diagnosed by a fellowship-trained spine surgeon. Enrolled patients completed the modified Japanese Orthopaedic Association scale (mJOA) for cervical myelopathy and our novel Fine Motor Skills (FiMS) iPad application. The FiMS iPad application consists of 4 unique challenges. All the challenges focus on the use of fine motor dexterity testing. Challenge 1 involves accurately tapping a moving target on the screen. Challenge 2 necessitates dragging a target on the screen to a goal. Challenge 3 involves moving a target through a maze without touching the maze walls. Challenge 4 is similar to Challenge 2, but requires the use of both hands to drag 2 separate targets to a goal. The scores are recorded independently for each challenge and the mean scores were used for data analysis. A student t-test was used to determine significance with a p-value set at < 0.01.

RESULTS: The average mJOA score (scale 0-18) for the myelopathic cohort was 11.4 with a score less than 12 being classified as severe myelopathy. The 71 control patients had a mean mJOA score of 17.4 with a score greater than 17 being inconsistent with myelopathy. Regression analysis of the healthy controls (n=71) showed that FiMS challenge scores decreased with age in all four challenges. When compared to age-matched healthy controls (n=44), the myelopathic cohort (n=12) had significantly lower FiMS scores for all challenges.

CONCLUSION: The novel Fine Motor Skills (FiMS) iPad application produced significantly lower scores in a myelopathic cohort when compared to an age-matched control cohort. In summary, the FiMS iPad application is a novel, easily administered, objectively quantifiable test for analyzing cervical myelopathy.

Intraoperative Spinal Cord Monitoring Does Not Decrease New Postoperative Neurological Deficits in Patients with Cervical Radiculopathy or Cervical Spondylosis with Myelopathy Undergoing One or Two Level ACDF

Abstract ID: Paper 171

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INTRODUCTION: Intraoperative spinal cord monitoring (IOM) is an established tool in reducing the incidence of new postoperative neurological deficits in scoliosis surgery. However, its utility in anterior cervical decompression and fusion (ACDF) remains a topic of debate—especially in the era of cost containment. Our purpose was to assess the utility of IOM (both SSEPs and Motor Evoked Potentials [MEPs]) in reducing postoperative neurological deficits in myelopathic and non-myelopathic patients undergoing ACDF. Furthermore, to describe the cost of IOM in ACDF. We hypothesized that patients with compared to without intraoperative monitoring would not differ in incidence of new postoperative neurological deficits in both myelopathic and non-myelopathic patients undergoing one or two level ACDF.

METHODS: Retrospective chart review was performed to include all ACDF procedures from 2008-2015. Charts were sorted by International Classification of Diseases, Ninth edition (ICD-9) codes to include only patients undergoing one or two level ACDF with cervical radiculopathy or cervical spondylosis with myelopathy. 249 total patients were included in the study. SSEP and MEP tracings were reviewed for all monitored patients and significant changes (i.e., changes requiring surgeon notification) and inconsistencies (i.e., fluctuations not requiring surgeon notification) were noted. IOM billing codes were reviewed to calculate the average procedural cost. Medical records were then reviewed for both monitored and non-monitored groups for new postoperative neurological deficit on postoperative day one and at six weeks and matched to the monitored tracings. The Fisher exact test was used to compare groups.

RESULTS: There were no differences in gender, age, or BMI between monitored and non-monitored groups. There was no difference in the proportion of patients with new neurological deficits in monitored compared with non-monitored patients with radiculopathy (6% vs. 0%, p=0.1935) or myelopathy (21.4% vs. 0%, p=0.1977). All new neurological deficits occurred in patients with either no IOM changes, or IOM inconsistencies only. No new neurologic deficits occurred in the non-monitored radiculopathy or myelopathy groups. The average IOM procedure cost was $6,500.

CONCLUSION: Our results suggest that intraoperative spinal cord monitoring does not reduce new neurological deficits in patients with radiculopathy or spondylosis with myelopathy. Because we found higher incidence in new neurological deficits despite no IOM changes in our monitored group, our study suggests a lack of utility of IOM in ACDF. Furthermore, at an average of $6,500 per IOM procedure, our study also underlines the importance of evaluating utility of IOM in the era of cost containment.

Staggered Instrumentation in Adults Undergoing Posterior Spinal Fusion: A Novel Technique for Soft Tissue Preservation and Prevention of Proximal Junctional Kyphosis

Abstract ID: Paper 172

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BACKGROUND: Proximal junction kyphosis (PJK) is a common complication of surgical treatment for adult spinal deformity. The incidence of PJK is reported at 20-40%; of these cases, about 50% will undergo revision surgery for PJK. Revision surgery for PJK approximately doubles the cost of surgical treatment for ASD and is estimated at 77,432 US dollars per revision surgery.

Risk factors contributing to PJK have been extensively investigated. Both patient specific and modifiable risk factors have been identified. Important modifiable risk factors include implant design, construct design, degree of correction, disruptions of posterior elements, and combined anterior/posterior procedures. Despite known, construct specific, modifiable risk factors, the optimal construct design to prevent PJK remains elusive.

METHODS: A total of 18 patients (3 men and 15 women) underwent posterior fusion using a unique, staggered technique for pedicle screw-rod construct, whereby the upper instrumented vertebra was varied by either 1 or 2 levels from the contralateral pedicle screw-rod construct. Patients were included if they were older than 18 years old and were undergoing either primary or revision surgery for ASD. Patients with previous surgery for ASD, including those with previous development of PJK were not excluded. Patients undergoing fixation for acute trauma, compression fracture, and neoplastic deformity were excluded. Follow-up ranged from 7 to 29 months. The primary outcome measure was defined as re-operation rate due to proximal junctional kyphosis. Secondary measures included the rate of complications such as PJK not requiring revision, pseudoarthrosis formation, instrumentation failure, infection, and upper instrumentation pain.

RESULTS: No patients required revision due to PJK. Three patients developed clinically significant PJK. Two patients developed asymptomatic loosening of the upper instrumented screw. Two patients developed upper instrumentation pain. Two patients required reoperation for infection. The average number of instrumented levels was 9.5 (range 5 to 15). On average, kyphosis at the proximal instrumented vertebra increased 6.9° (range -3° to 17°).

CONCLUSIONS: Staggered instrumentation for ASD involving the thoracic spine is a safe, tissue sparing technique which may limit the development of PJK.

Aggressive Venous Thromboembolism Chemoprophylaxis Appears Safe When Given in Combat-Related Spine Trauma

Abstract ID: Paper 173

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BACKGROUND/INTRODUCTION: Deep venous thrombosis (DVT) and pulmonary embolism (PE) are well-known complications of spine trauma. These complications are further compounded in the combat setting, where care is often deferred and treated in an echeloned fashion. The risks of adverse reactions to thromboembolism chemoprophylaxis (e.g., spinal epidural hematomas, gastrointestinal bleed, heparin-induced thrombocytopenia, allergic reactions, etc.) have to be weighed against the benefit of DVT/PE prevention. An aggressive clinical practice guideline (CPG) (i.e., prophylactic subcutaneous enoxaparin or heparin) was established to standardize utilization of chemoprophylaxis in patients sustaining traumatic injuries in the combat zone, but its effect on spine-injured patient outcomes is unknown.

METHODS: The records at a single military trauma center in Europe as well as the DoD Trauma Registry were retrospectively reviewed for all patients evacuated from Iraq/Afghanistan in 2012 for in-patient care with major spinal fractures. Information regarding injuries, surgeries, contraindications for mechanical prophylaxis or chemical prophylaxis, use of enoxaparin/heparin, results of DVT-screening ultrasounds, detected cases of DVT/PE, deaths and complications of chemoprophylaxis were recorded. The primary outcomes were compliance and utilization.

RESULTS: 89 patients whose LOS averaged 73 hours (96 vs. 57 hours for those who did/did not have surgery in Germany; $p<.002$) were included. 10 of 89 (11.2%) developed a DVT (n=5) or PE (n=5). 2 patients died, but neither from DVT/PE or bleeding causes (1 sepsis, 1 cardiac arrest). 1 patient had an IVC filter placed in Afghanistan. Compliance rate was 95.5% (=85/89). 26.7% of patients missed at least 1 possible dose. Thus, utilization of chemoprophylaxis in the traumatized patients, despite an aggressive protocol, was limited to 73.3%, with most missed doses held for surgery. Conversely, almost three-quarters of patients received all doses with no major complications related to chemoprophylaxis reported. One patient had a small superficial hematoma. Of the 35 patients who had surgery, only 36.4% received all possible doses during their stay, while 94.3% of patients who did not have surgery received all possible doses ($p<.001$).

DISCUSSION/CONCLUSION: When chemoprophylaxis was used in spine-injured patients, it was safe and well-tolerated; however, the need for frequent surgeries in these patients reduces the number of doses given. The observed DVT/PE rate was relatively low for this population, especially given the unique challenges of combat casualty care, and there were no major complications related to chemoprophylaxis. This was the first study to evaluate aggressive chemoprophylaxis for DVT/PE in the multi-trauma spine-injured service member.

Vertebral Insufficiency Fractures After Short-Segment Lumbosacral Fusion: Case Series and Systematic Review of Literature

Abstract ID: Paper 174

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BACKGROUND/INTRODUCTION: Vertebral insufficiency fractures are a relatively rare complication following short segment lumbosacral fusion that is an often overlooked and underdiagnosed source of acute pain in the postoperative period. Sacral and vertebral insufficiency fractures are usually indications of poor bone mineral density and correlate with DEXA-measured osteoporosis in >95% of patients. Most insufficiency fractures are atraumatic, not detected by conventional radiographs, and are often undiagnosed for weeks to months.

MATERIALS/METHODS: A systematic Medline search was conducted looking for case reports and case series of short segment (L4-S1 and/or L5-S1) lumbosacral fusions complicated by vertebral insufficiency fractures. A case series of patients with this diagnosis was compiled at our institution as well. Age, gender, segments, surgical fixation, medical history, bone mineral density, time to fracture, and treatment method were recorded.

RESULTS: A literature reviewed showed 11 cases in the literature of insufficiency fracture following short segment lumbosacral fusion, and five more cases were recently seen at our institution. Most of the cases have a new onset sacral insufficiency fracture in the early postoperative period (range: 1 day - 4 months, median: 31 days). The majority of patients requiring further spinal fixation had ALIF without posterior fixation (7/10), whereas all patients successfully treated nonoperatively had posterior fixation (6/6). Indications for surgery included new onset neurologic deficit, recurrence of original deformity, and intractable pain after exhaustion of nonoperative measures. Successful nonsurgical management included osteoporosis treatment, some sort of lumbosacral orthotic, encouraged ambulation, and pain control.

DISCUSSION/CONCLUSION: Vertebral insufficiency fracture is a rare complication following short-segment lumbosacral fusion that is often missed. These types of fractures are more amenable to nonoperative treatment if the preceding surgery had posterior fixation. The majority of these fractures occurred in patients with no previous diagnosis of bone mineral abnormalities, and a high index of suspicion should be reserved for acute pain in the early postoperative period even in young patients without obvious causes of osteoporosis.

Cost Effectiveness Analysis for Spine Surgical Procedures in a Large Metropolitan Healthcare System

Abstract ID: Paper 175

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PURPOSE: Approximately 1.15 million spinal surgeries are performed in the United States per year. In 2008 the aggregate hospital bill for surgical treatment of spinal conditions was $33.9 billion and rates of common spinal procedures have increased rapidly since then. Extensive literature has been reported evaluating outcomes and cost utility for spinal surgeries however specific cost analysis literature is limited. The purpose of this study is to provide a cost analysis of spine surgery in a high volume metropolitan healthcare system to examine the variables impacting cost effectiveness.

METHODS: A retrospective cost-identification study design was used to evaluate cost data from two large hospital locations within a metropolitan hospital system. The data was separated and variations analysed based on the following categories: surgery type, diagnosis, surgeon volume, surgeon sub-specialty, Primary CPT codes, additional CPT codes, total surgical costs, materials used for the procedure, cost of materials, surgery length, length of hospital stay, and reimbursement rate. Relating to surgeon volume, surgeons with more than 100 cases performed were considered high volume. Statistical analyses included logistic regression, chi-square cross tab analysis, and multinomial regression.

RESULTS: There were 9,396 spine procedures performed at the two sites between 2010 and 2014, with 64% at Hospital 1 (H1) and 36% at Hospital 2 (H2). The overall contribution margin and net income were positive with implants, surgical supplies/dressings, and operating room supplies making up the majority of the direct costs. Net income consistently increased every year (avg. $4,450 in 2010 to $10,384 by 2014). The average implant cost decreased from 2010 to 2014 ($6,999 to $5,059) and the average biologics cost increased ($1,087 to $2,030). There was a direct correlation between implant cost and contribution margin amongst high volume surgeons. There were significant differences in contribution margin ($p=0.001$) and net income ($p=0.001$) based on the institution where the spinal procedure was performed. The most common CPT codes (greater than 10) all correlated with positive income and contribution margins.

DISCUSSION: Overall, our data clearly illustrates the profitability of spinal surgery for large healthcare system which is on the rise. Continued cost effectiveness strategies need to focus on cost of implants and biologics for these procedures especially for high volume surgeons. Continued optimization of CPT coding and hospital cost factors will also optimize profitability for these procedures.

MAOA BREAKOUT SESSION #13
KNEE ARTHROPLASTY
April 22, 2017

Identifying Risk Factors for the Development of Stiffness Following Total Knee Arthroplasty

Abstract ID: Paper 176

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INTRODUCTION: Total knee arthroplasty (TKA) is a reliable surgical procedure for relieving pain. However, stiffness following TKA, can cause significant morbidity and distress to the patient. The pathogenesis and risk factors for the development of arthrofibrosis are not understood. Risk factors for postoperative stiffness include preoperative range of motion, diabetes, and lung disease. However, these studies are limited by small cohort size. Therefore, the purpose of this study was to use a large multicenter database to evaluate risk factors for manipulation under anesthesia (MUA).

METHODS: The Humana administrative claims database was reviewed from 2007 to 2015 for all patients who underwent TKA. The incidence of ipsilateral MUA following of total knee arthroplasty was determined, and the odds ratio (OR) with 95% confidence intervals (CI) were then calculated. Risk factors analyzed included preoperative narcotic use (3 months prior to TKA), smoking status, diagnosis of anxiety and/or depression, fibromyalgia, diabetes type II (DMII), obesity, and patient age and sex.

RESULTS: In total, 103,471 TKAs were included in the study and of these, 2,111 (2.04%) underwent ipsilateral MUA for postoperative stiffness. Patients less than 50 years of age had significantly higher odds of requiring MUA compared to older patients (>50 years) (OR 2.83 (CI: 2.27 to 3.54, p< 0.0001). Male gender had significantly less odds of MUA compared to females (OR: 0.84 [CI: 0.77 to 0.93], p=0.0005). Obese patients had significantly less odds of MUA compared to non-obese patients with an OR 0.83 (CI: 0.74-0.92, p=0.0004). We identified 29,437 TKAs (28.48%) who had a history of narcotic use prior to TKA with 599 (2.09%) of these requiring MUA compared to 979 (2.04%) TKAs requiring MUA without a history of narcotic use (OR: 0.97 CI: 0.88 to 1.08). Additionally, a diagnosis of anxiety and/or depression, fibromyalgia, and DMII did not significantly affect the odds of subsequent MUA with OR of 0.87 (CI: 0.73 to 1.05), (0.89 (CI: 0.78 to 1.02) and 0.95 (CI: 0.87 to 1.04), respectively.

DISCUSSION AND CONCLUSION: Arthrofibrosis is a relatively uncommon complication following TKA (2% rate of MUA); however, its sequelae can be frustrating to both patient and physician and can lead to patient dissatisfaction. In this study, obesity was protective of subsequent MUA. Young age and female sex significantly increased odds of undergoing MUA. Defining these risk factors provides the physician tools to better counsel their patients during pre-perative evaluation for their risk of developing stiffness following TKA.

Incidence and Risk Factors for Total Knee Arthroplasty After Knee Arthroscopy in Patients Over 50 Years of Age

Abstract ID: Paper 177

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Several orthopedic registries have described the incidence of total knee arthroplasty (TKA) after knee arthroscopy. Patient risk factors may play a role in the conversion rate from knee arthroscopy to TKA. This study quantifies the incidence of the conversion of knee arthroscopy to TKA from an American, mixed-payer database. It also describes some of the common patient risk factors for that conversion. The medical records of more than 50 million patients treated between 1998 and 2014 were mined using a commercially available software platform. During the study period, a total of 68,090 patients over the age of 50 underwent knee arthroscopy for partial meniscectomy, chondroplasty, or debridement. The incidence of TKA at one, two, and three years after undergoing arthroscopy was 10.1%, 13.7%, and 15.6%, respectively. Obesity, depressive disorder, rheumatoid arthritis, diabetes, and age >70 showed increased relative risk of conversion to TKA at two years. When obesity was combined individually with the top five other risk factors, no combination produced a higher relative risk than that of obesity alone. Patients 50-54 years of age had the lowest incidence of conversion to TKA (8.3%, P<.001). Males had a lower incidence of conversion to TKA (11.3%), than females (15.8%, P<.001). This information can help surgeons counsel their patients regarding the incidence of total knee arthroplasty after undergoing knee arthroscopy and identify preoperative risk factors that place patients at higher risk.

Patient Functional Activity Level and Performing Surgeon Affect Patient Satisfaction After Modern Total Knee Arthroplasty

Abstract ID: Paper 178

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INTRODUCTION: Healthcare reform has forced patient satisfaction into focus. Patient dissatisfaction following total knee arthroplasty (TKA) is frequently quoted at 15-20%. The purpose of this study was to determine whether modern TKA has improved the overall patient satisfaction rate and determine if specific predictors of patient satisfaction exist.

METHODS: A retrospective review of a joint replacement database was performed on 576 consecutive TKA patients from 5/21/12 to 5/31/15. Other than TKA bearing (cruciate-retaining vs. cruciate-substituting), the two TKA-performing surgeons utilized identical implants, nursing and surgery staff, and perioperative protocols. The modern Knee Society Score (KSS) and a single “global” patient satisfaction question are routinely collected for all TKA patients, as well as demographic data. The satisfaction component of the KSS and the single satisfaction question were analyzed for correlations with $p < 0.05$ significant.

RESULTS: After exclusions for statistical confounds, 517 TKAs remained and 79.1% were available with minimum one-year follow-up. Average patient age was 64.3 years and 66.7% were female. Overall, 86.6% of patients were “satisfied” or “very satisfied”, 7.8% “neutral” and 5.6% “dissatisfied” or “very dissatisfied” with their TKA. Age and gender did not correlate with patient satisfaction ($p = 0.5$; $p = 0.06$, respectively) with numbers available. Surprisingly, patient satisfaction rates differed between surgeons (91% vs. 80%; $p = 0.005$), as did mean KSS satisfaction scores ($p = 0.02$). KSS Function scores positively correlated with both global patient satisfaction and KSS Satisfaction scores ($p < 0.0001$).

CONCLUSIONS: In primary TKA performed with modern protocols by experienced surgeons, patient satisfaction remained suboptimal at 86.6%, consistent with previous research. Further, the surgeon and patient function scores were strong predictors of satisfaction. Collaborative sharing of strategies by surgeons with superior satisfaction rates and a focus on optimizing patient function may improve patient satisfaction after primary TKA.

Utilization of Knee Magnetic Resonance Imaging Prior to Orthopedic Referral in Patients 50 Years or Older

Abstract ID: Paper 179

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INTRODUCTION: Magnetic resonance imaging (MRI) is used with increasing frequency for the evaluation of knee pain. Adult patients greater than 50 years old have a high likelihood of degenerative disease as a source of their knee pain. We hypothesize that MRI may provide clinically irrelevant information in this population. The aim of this investigation was to analyze the appropriate utilization of MRI prior to referral of patients greater than 50 years old with knee pain.

METHODS: This study was designed as a retrospective analysis of consecutive internal patient referrals (from within our institution) to our orthopedic clinics over a six-month time period. Patient data was collected from our academic (University) and Veteran's Affairs (VA) sites. An exempt status was provided from the institutional review boards of each institution. Inclusion criteria were age greater than 50 years of age and evaluation for isolated unilateral or bilateral knee pain. Exclusion criteria were: incomplete referral records, known history of inflammatory or crystalline arthropathy, trauma within two months of visit, surgery on the knee within one year, and self-referral or intradepartmental orthopedic referral. MRIs were deemed inappropriate in the setting of a failure to perform plain radiographs prior to MRI, a radiographic demonstrating joint space narrowing or osteophyte formation, or a benign neoplastic process requiring no further evaluation. The means between the two groups were compared with use a Chi-square test, with statistical significance considered $p < 0.05$.

RESULTS: 357 total patients, with an average age of 66.1 years, met our enrollment criteria over a six-month consecutive period. 225 (63%) patients presented with radiographs and 44 (12.3%) presented with an MRI. 36 (81%) of the MRIs ordered prior to referral were inappropriate. There was no difference in age or the proportion of inappropriate MRIs between the two institutions. Providers at the VA ordered more radiographs compared to the University (141 and 84, respectively, $p<0.01$) and more MRIs prior to referral (27 and 17, respectively, $p<0.01$). More VA MRIs were inappropriate (22 and 14, respectively, $p=0.012$).

CONCLUSIONS: The majority (81.8%) of the MRIs performed to evaluate knee pain in patients older than 50 were unnecessary based on our criteria. This investigation suggests the need to establish a protocol for the advanced imaging evaluation of patients greater than 50 years old with knee pain.

Analysis of Outcomes Following TKA: Do All Databases Produce Similar Findings?

Abstract ID: Paper 180

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INTRODUCTION: Use of large database for orthopedic research has increased exponentially. Each database represents unique patient populations and vary in their methodology of data acquisition. The purpose of this study was to evaluate differences in reported demographics, comorbidities, and complications following total knee arthroplasty (TKA) amongst four commonly used databases.

METHODS: Patients who underwent primary TKA during 2010-2012 were identified within National Surgical Quality Improvement Programs (NSQIP), Nationwide Inpatient Sample (NIS), Medicare Standard Analytic Files (SAF), and Humana Claims Database (HCD). NSQIP definitions for comorbidities and surgical complications were matched to corresponding ICD-9 and CPT codes and these coding algorithms were used query NIS, SAF, and HCD. Age, sex, comorbidities, inpatient and 30-day postoperative complications were compared (NIS has inpatient data only) using standard statistical techniques.

RESULTS: The number of primary TKA patients from each database was 48,248 in HCD, 783,546 in SAF, 393,050 in NIS and 43,220 in NSQIP. Databases were similar in their gender distribution (1.7-1.8:1 female to male). Age distribution was clinically similar between databases, but slightly older in HCD and SAF. There was variation in prevalence of comorbidities and rates of postoperative complications between databases. Prevalence of COPD and coagulopathy in HCD and SAF were more than twice those in NIS and NSQIP. NSQIP had more than twice the obesity than NIS. Rates of stroke 30 days after TKA had more than twofold difference between all databases. HCD had more than twice the rates of 30-day complications at all endpoints compared to NSQIP and more than twice the 30-day infections than SAF.

CONCLUSIONS: There is considerable variation in complication rates following TKA depending upon the database used for analysis. It will be important to consider these differences when critically evaluating database research. With the advent of bundled payments, these differences must be considered in risk adjustment models.

Computer Navigated Total Knee Arthroplasty: Rates of Adoption and Early Complications

Abstract ID: Paper 181

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INTRODUCTION: When new technologies are introduced into the marketplace, especially in areas of medicine that are high cost and which have already demonstrated high value (such as TKA), it is important to evaluate the rate of adoption of these technologies as well as the short- and long-term outcomes including complications and benefits in comparison to pre-existing technology. The purpose of this study was to determine the adoption rate of computer navigated TKA and the short-term complication rate of the procedure when compared to TKA performed without navigation.

METHODS: The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database was used to identify 72,396 patients undergoing TKA from 2010 to 2013. Common Procedural Terminology (CPT) codes were used to identify cases of navigated and traditional TKA. Rates of adoption of the computer navigated TKA were determined. Univariate and multivariate analyses were performed to determine differences in outcomes while identifying risk factors for morbidity.

RESULTS: 3.4% of TKA was completed with navigation. Reoperation was significantly increased in the navigated group (1.74% vs. 1.15%, $p=0.007$). There was a decreased transfusion rate in the navigated group (13.84% vs. 10.58%; $p<0.001$). There were no significant differences between groups for all cause complications, operative time, unplanned readmission, or length of stay.

CONCLUSIONS: With respect to short-term complications, operative time, length of stay, and unplanned readmission, there were no differences between navigated and traditional TKA. The decreased transfusion rate in the navigated group corroborates previous studies. Return to the operating room was higher in the navigated group. Over the four year study interval, only 3.4% of TKAs were completed with navigation, hence a relatively low rate of adoption.

Effect of Body Surface Area on Outcomes After Total Knee Arthroplasty

Abstract ID: Paper 182

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INTRODUCTION: Increasing body mass index (BMI) has been shown to correlate with increased rates of complications after total knee arthroplasty (TKA). Body Surface Area (BSA) has not been investigated in this manner. BMI and BSA are affected differently by changes in height, while they are affected equally by changes in weight when using the Mosteller formula. The purpose of this study was to quantify implant survival and other common complications after TKA using BSA as a continuous variable.

METHODS: Prospectively collected data from a single institution's total joint registry was used to analyze 22,252 consecutive knees, treated with a primary TKA from 1985-2012. The Mosteller formula was used to calculate BSA. The average BSA at the time of surgery was 2.0 m^2 (range, 0.7-3.2 m^2). The patient's average age was 68 years at time of surgery, and 56% of patients were female. The Kaplan-Meier survival method was used to evaluate mechanical failure, reoperations, and common complications. Smoothing spline parameterization was used on BSA in these models. The associations of patient factors with the risk of each outcome were assessed using Cox regression analysis, adjusting for correlated knees. Statistical significance was set at a p-value <0.05.

RESULTS: Increasing BSA was associated with an increased risk of revision surgery, reoperation, mechanical failure, and infection after TKA. Revision surgery risk was directly associated with BSA (HR 2.84, $p<0.01$) per 1 unit increase in BSA. This association was especially demonstrated between increasing BSA and revision for mechanical failure (HR 2.75, $p<0.01$). Subgroups of mechanical failure were also associated with increasing BSA, including revision surgery for aseptic loosening (HR 3.91, $p<0.01$) and polyethylene wear (HR 1.96, $p<0.01$). Increasing BSA was also associated with increased risk for reoperation (HR 1.73, $p<0.01$) and infection (HR 2.67, $p<0.01$). There was no correlation between BSA and risk of venous thromboembolism or knee manipulation.

CONCLUSION: BSA was strongly associated with the rates of revision, reoperation, and many other common complications following total knee arthroplasty. When compared to our previously published data on BMI and outcomes after TKA, BSA appears to correlate more strongly with outcomes. These findings are important to consider when counseling patients, estimating risk, and utilizing a comprehensive team approach to reduce risks.

Unicompartmental Knee Arthroplasty is Safe to Perform in an Outpatient Surgery Center

Abstract ID: Paper 183

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INTRODUCTION: Unicompartmental knee arthroplasty (UKA) has been established as an alternative to total knee arthroplasty(TKA) in selected patients with predominantly isolated compartment osteoarthritis. The less invasive nature and rapid early recovery of UKA lends itself to performance in the outpatient setting. Prior literature has demonstrated a low rate of readmission and postoperative complications when performed in a hospital outpatient setting (HOP). To our knowledge, there have been no studies evaluating early complications, including readmissions, of UKA performed at an outpatient surgery center (OSC). OSC settings provide some unique advantages to HOP, but the concern for transfer of care remains should problems arise. This series evaluates the 90-day complications and readmissions after UKA performed in an OSC compared to a similar patient cohort in a HOP.

METHODS: We retrospectively reviewed all patients that underwent outpatient UKA by a single surgeon from 2012-2016. There were 569 UKAs performed: 288 OSC group and 281 HOP group. Patients scheduled to have an overnight stay in the hospital were excluded from the study. We compared the two groups with regard to all complications within the first 90 days after surgery: including readmissions, emergency department (ED) visits, and surgical and medical complications.

RESULTS: There were no significant demographic differences except for a higher BMI in the HOP group (30.2 vs. 29.4) (p=0.04). The two groups were comparable with regard to age. Thirty major and minor complications occurred within 90 days (5.3%) across the two groups. There was no difference in the overall 90-day complication rate between the groups (OSC 4.2%, HOP 6.4%) (p=0.26). There were 2 deep infections requiring operative treatment, both in the HOP group (0.07%, p=0.24). Emergency department visits occurred within 7 days in 3 OSC cases (1.0%) and 4 HOP cases (1.4%) (p=0.72). One ED visit from each group occurred <24 hours after surgery(OSC 0.3%, HOP 0.4%)(p=1.0). One unplanned day-of-surgery admission occurred in the HOP group (0.4%) and none occurred in the OSC group. Readmissions within the first 90 days after surgery occurred in 5 OSC cases (1.7%) and 8 HOP cases (2.8%) (p=0.41).

CONCLUSION: In the largest study of its kind, UKA is a safe intervention for selected patients with an overall low risk of infection and early complication. UKA at an OSC has a low early postoperative complication rate without increased risk of readmission or ED evaluation when compared to UKAs performed at a HOP. These findings would support the use of a bundled payment model for UKAs with low inherent risk performed at OSCs.

Causes and Trends Through the 90-day Episode of Care of Readmissions After Total Knee Arthroplasty: A Large Database Study

Abstract ID: Paper 184

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INTRODUCTION: Recent guidelines by Centers for Medicare and Medicaid Services (CMS) stipulate a 90-day global period for hospitals for unplanned readmissions after primary total knee arthroplasty (TKA). However, not all readmissions are directly attributable to index surgery and reasons for readmissions vary during this time period. This study identifies causes and temporal relations of these readmissions using large state inpatient databases.

METHODS: State inpatient databases of New York and California were queried for all primary TKA (ICD-9-CM 81.54) performed from 2005-2011 and frequencies of all causes of unplanned readmission were identified from 0-90 days after index surgery using ICD-9 diagnosis and procedure codes. Only readmissions directly related to prosthesis or postoperative state were deemed procedure-related. Demographic (age, race, gender, insurance status), facility (hospital location, teaching status), and clinical characteristics (discharge status, blood transfusion) were identified. Temporal differences in proportions of readmission diagnoses were tested for using Pearson's chi-square test.

RESULTS: The query identified 419,805 cases of primary TKA during the study period, mean age 67 years (±10), predominately female (62%), and mean length of stay of 3.6 days (±1.9). There were 26,924 readmissions during the 90-day recovery period, with 15,547 (57.7%) at 0-30 days, 6,593 (24.5%) at 31-60 days, and 4,784 (17.8%) at 61-90 days. Throughout the 90-ay period, the majority of primary diagnoses at readmission were not directly related to index surgery. The proportion of procedure-related readmissions varied significantly over the 90-day period, dropping from 0.338 (0-30 days) to 0.163 (61-90 days) ($p<0.001$).

CONCLUSION: Causes of unplanned readmission after TKA are numerous and demonstrate varying temporal trends over the recovery period. From this analysis of two large state inpatient databases, the majority of all primary diagnoses at readmission may not be directly attributable to index surgery and postoperative state up to 90 days. These findings suggest that the current 90-day global period policy for this procedure should be reformed to better reflect the profile of unplanned readmissions after TKA.

A Perioperative Patient Management Support System Mitigated the Risk of Hospital Readmission for High Risk TKA Patients

Abstract ID: Paper 185

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INTRODUCTION: Age, race, socioeconomic status (SES), and systemic comorbidities have been individually identified as factors related to increased risk of hospital readmissions following primary total knee arthroplasty (TKA). Utilization of a patient management support system in our clinical pathway has been successfully demonstrated to both reduce the length of hospital stay, as well as reducing the number of hospital readmissions.

METHODS: We identified all primary TKAs performed at a single institution between 2013 and 2015. Patient sex, age at the time of surgery, race, ASA grade, and 120-day readmissions were retrieved from the patient's medical record. The patient's home address was used as a proxy for SES, with those living in economically depressed areas considered to have lower SES. Patients were categorized as living in economically depressed areas if the median household income for patients of similar ethnicity living within their zip code was < $25,000. A binary regression was used to determine if a model of patient factors could accurately predict 120-day readmission after primary TKA, and the individual effects of each categorical factor on readmissions were also assessed.

RESULTS: A sample of 937 primary TKAs was identified using the above criteria, of which 786 (83.9%) were Caucasian and 128 (13.7%) were African Americans. With the remaining sample of 914 TKAs, a model containing age, sex, race, SES, and ASA grade was unable to accurately predict the need for hospital readmission ($R^2 = 0.02$). When assessed individually, the rates of hospital readmission did not differ by sex, race, SES, or ASA grade.

CONCLUSION: The use of a perioperative patient management system appears to have mitigated the risk of readmission in subsets of high-risk patients. Implementation of similar programs may then help to reduce disparities for disadvantaged patient populations and improve patient outcomes while reducing the overall cost to the healthcare system. The 4.5% rate of readmission represents a substantial reduction to the rates prior to implementing the patient management system, it highlights the need to further reduce the prevalence of postoperative complications and hospital readmissions.

Long-Term Outcome of Knee Arthroplasty in the Setting of Pigmented Villonodular Synovitis (PVNS)

Abstract ID: Paper 186

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INTRODUCTION: Pigmented villonodular synovitis (PVNS) is a rare, benign exuberant proliferation of the synovium, commonly affecting the knee. Arthroplasty has been performed successfully to manage arthrosis in this population; however, these results come from small patient series. The purpose of this study was to investigate the oncologic and functional outcome of patients undergoing arthroplasty in the setting of PVNS with a focus on (1) disease specific survival, (2) complications and reoperation, and (3) patient function.

METHODS: Forty-eight patients were identified with histologically confirmed PVNS that subsequently received knee arthroplasty between 1971-2013. All patients were followed for a minimum of two years with mean follow-up of 14 years. There were 20 males and 28 females with a mean age of 61 years and mean body mass index of 29.2 kg/m^2. Prior to the arthroplasty, 35 patients had at least 1 surgical procedure to treat the PVNS. At the time of surgery, 37 patients had “active” disease, defined by the presence of proliferative synovial tissue and histologically confirmed PVNS. These patients underwent removal of diseased synovium or focal areas of PVNS at the time of TKA.

RESULTS: The 10-year disease free-survival was 88%. Recurrence occurred in 5 patients at mean 6 years following the arthroplasty. Recurrence was treated with synovectomy and revision arthroplasty (n=4) and transfemoral amputation (n=1). Following primary arthroplasty, 25 patients (52%) sustained at least 1 complication, most commonly decreased knee range of motion (ROM; n=12). Complications resulted in an additional procedure in 15 patients (31%) and revision in 10 patients (21%). There was no difference (P=0.74) between mean pre- and postoperative ROM (99° vs. 101°); however, there was a significant reduction in the number of patients with a flexion contracture >15° (8 preop vs. 1 postop; P=0.03). Prior to surgery the mean Knee Society Score (KSS) and KSS Functional (KSSf) score were 54 (range 20-77) and 45 (range 0-90). There was a significant improvement in both the KSS (mean 87, range 37-100, P<0.0001) and KSSf (mean 62, range 0-100, P=0.01) following the arthroplasty.

CONCLUSION: The results of this study indicate arthroplasty in the setting of PVNS improves patient function and reduces the presence of flexion contractures. However, given the high rates of reoperation and revision surgery, patients with a history of PVNS should be cautioned when undergoing arthroplasty on the elevated risk of subsequent procedures.

National Trends in Above-the-Knee Amputations After Failed Total Knee Arthroplasty

Abstract ID: Paper 187

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BACKGROUND: The projected increase in the annual number of total knee arthroplasties (TKA) performed in the United States (US) is expected to be accompanied by an increase in the volume of complications associated with TKA. Above knee amputation (AKA) is a rare but devastating complication of TKA. The purpose of this study was to describe the trends for AKAs performed for failed TKA in the United States from 2000 to 2011.

METHODS: Using Nationwide Inpatient Sample from 2000-2011, AKAs resulting from a failed TKA were identified using a combination of ICD-9 procedure and diagnosis codes. Standardized AKA volumes were calculated for different age, gender, and racial groups by dividing the annual number of AKA in each group with corresponding number of TKA. Regression analysis was used to study the annual changes in the number of absolute and standardized AKA volumes.

RESULTS: From 2000 to 2011, a total of 9,733 AKA were performed, of which 8,104 (83%) were done for septic failures and 1,629 (17%) for aseptic failures of TKA. The annual number of AKA procedures increased by 107%, from 522 procedures in 2000 to 1,083 procedures in 2011. The increase in the AKA was significantly higher for the 2000-2005 period than the 2006-2011 period ($p<0.001$). Standardized AKA volume remained stable from 2000 to 2011 ($p=0.077$). The mean annual standardized AKA volume was significantly higher in males ($p<0.001$) and African Americans ($p<0.001$).

CONCLUSIONS: The number of AKA performed for failed TKA in the U.S. has increased in the recent years. This increase is likely to be driven by the rising demand for TKA as denoted by the stable standardized AKA volumes. Gender and racial disparities exist in the standardized volumes of AKA after a failed TKA. Given the functional impairments associated with AKA, effective measures to control this rare complication of TKA should be undertaken.

Guided vs. Freehand Patella Resurfacing: The Effect on Patella Tracking

Abstract ID: Paper 188

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INTRODUCTION: Resurfacing of the patella is a routine part of total knee arthroplasty for many surgeons. Various surgical guides and techniques have been proposed for resurfacing of the patella yet few comparisons have been made in the literature to evaluate how patella tracking is effected by the chosen technique.

METHODS: 153 patients were identified who underwent total knee arthroplasty (TKA) at a single institution over a two-year period and met inclusion criteria and were retrospectively reviewed. Patients were divided into two groups. Group I were patients who underwent TKA with patella resurfacing using a guide, and Group II were those who underwent TKA with patella resurfacing using a free hand technique. Radiographic parameters were assessed to determine the patellar tilt, tracking, and subluxation. Incidence of lateral release was also recorded.

RESULTS: The amount of patella resected was not significantly different between the two groups ($p = 0.62$). The postoperative patellar thickness was similarly restored for both groups ($p = 0.51$). The lateral patellofemoral angle was improved in both groups postoperatively, and no significant difference was seen between the groups ($p = 0.99$). Patellar subluxation was similarly improved an average of 5.3 mm for both groups ($p = 0.97$). A lateral release was performed in 20% of the patients who underwent guided patellar resurfacing and in 22% of the patients who underwent freehand patellar resurfacing ($p = 0.99$).

CONCLUSION: No statistically significant differences were found between guided patellar resection and free hand patellar resection in the radiographic assessment of patellar tracking. The experienced surgeon can expect similar results regardless of the method chosen for resurfacing the patella during total knee arthroplasty.

Patella Mal-Tracking Does Not Affect Clinical Outcomes After Modern Total Knee Arthroplasty

Abstract ID: Paper 189

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INTRODUCTION: The focus of patella mal-tracking after TKA has traditionally been on eccentric wear and patella polyethylene damage, rather than on diminished functional outcomes. The purpose of this study was to determine if postoperative lateral patella tilt and subluxation after TKA resulted in inferior clinical outcomes.

METHODS: A retrospective review of consecutive primary TKAs performed via a median parapatellar approach was performed. Patella tilt and subluxation were measured according to the new Knee Society Radiographic Scoring System. Modern Knee Society Scores (objective, functional, and satisfaction components), EQ5D, and UCLA activity level were assessed at minimum one-year follow-up. Statistical analysis was performed with $p < 0.05$ as significant.

RESULTS: 225 consecutive cruciate-retaining TKAs were included, 8% were lost to follow up, leaving 207 TKAs with radiographic and clinical follow-up at a mean 24.3 months (range, 9-65). Mean age and BMI were 65.5 years and 34.2, respectively. 66.2% of patients were female. Overall, patella tilt was corrected a mean 2.5° to a mean of 4.6° postoperative lateral tilt. Lateral patellar displacement corrected 6 mm to a mean of 2.6 mm postoperatively. Postoperative tilt and displacement had no effect on Knee Society Scores, EQ5D, or pain scores with numbers available ($p > 0.2$). Both obesity and UCLA activity level were correlated with postoperative lateral displacement ($p < 0.04$). However, when BMI was controlled for, only BMI negatively influenced postoperative activity level ($p = 0.019$), rather than patellar displacement.

CONCLUSION: Findings support that patella tilt and lateral displacement in modern TKA do not affect clinical outcomes. However, suboptimal patellar tracking may potentiate edge loading of the polyethylene and contribute to implant damage in the longer term. This data is helpful in order to focus efforts on the tibio-femoral articulation as the predominant determinant of patient outcomes.

Intra-Ocular Pressure Changes Associated with Intra-Articular Knee Injections of Kenalog for the Treatment of Knee Arthritis

Abstract ID: Paper 190

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BACKGROUND: Intra-articular steroid injections are a common first line therapy for inflammation associated with severe osteoarthritis. An estimated 27 million people currently diagnosed with osteoarthritis in America, with a large number of those receiving intra-articular steroid injections as treatment. It has been well documented that intraocular pressure (IOP) elevation can occur as an adverse effect of corticosteroid therapy, regardless of delivery method. The ocular hypertensive response to topical dexamethasone is due to a reduction in aqueous outflow and is more severe in older patients. If the ocular hypertensive effect is of sufficient magnitude and duration, damage to the optic nerve (steroid-induced glaucoma) can occur. There have been no published studies to date investigating the change in IOP following an intra-articular steroid injection.

HYPOTHESIS: Intra-articular injections of steroids produces an elevation in intra-ocular pressure (IOP).

METHODS: Methods: We prospectively collected data from 31 patients who underwent injection of 40 mg of Kenalog into their knee from December 2015 to March 2016. Intraocular pressures were taken using a handheld tonometer, Tonopen at time of enrollment, 1 week, and 1 month. Patients were considered steroid responders if they had >7 mm Hg increase in their IOP from baseline.

RESULTS: Mean IOP at baseline was 18.1 ± 5.7 mm Hg for the right eye and 21.4 ± 7.1 mm Hg for the left. Mean IOP for all patients at 1 week was 22.7 ± 10.2 and 23.6 ± 10.9 for right and left eyes, respectively. This increase was not significant as a group. However, in the steroid responder group, nine patients (29%) had a significant increase in IOP at 1 week, to 33.3 ± 11.2 mm Hg in the right eye ($p<0.004$) and 35.3 ± 10.7 mm Hg in the left ($p<0.0007$). This was an average individual increase of 18.7 mm Hg or 99% ($p<.005$). At 1 month, 4 of the patients (13%) in the steroid responder group had a sustained mean IOP elevation of 16 mm Hg from baseline ($p<0.0004$).

CONCLUSION: One in four patients appear to have a significant IOP elevation following intra-articular steroid injection for the treatment of osteoarthritis of the knee.

Cementless Total Knee Arthroplasty in Morbidly Obese Patients: Outcomes and Complications

Abstract ID: Paper 191

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INTRODUCTION: Total knee arthroplasty (TKA) using cement in the morbidly obese population is associated with decreased outcomes and increased complications. Few studies have addressed this population using cementless TKAs as an alternative to cemented components. The purpose of this study is to determine the outcomes and complications of primary cementless TKA in morbidly obese patients (BMI >40) in comparison to a matched cohort with BMI<35. Our hypothesis is that cementless TKAs, which offer biologic fixation, may have fewer complications.

METHODS: Following IRB approval, records were retrospectively reviewed on morbidly obese subjects who underwent cementless TKA with at least 2-year follow up. Demographic, clinical, surgical, and radiographic data was extracted for all study patients. Knee Society Scores (KSS) and postoperative complications were also recorded. A matched cohort for patients with BMI<35 was extracted in a similar manner. There were 72 patients in the morbidly obese group and 72 patients in the matched cohort. Average follow-up was 34.4 months and 33.4 months in each group, respectively. All data was recorded on an Excel spreadsheet for analysis. Student t-test and Chi-square tests were run to determine significant differences.

RESULTS: Average BMI in the >40 group was 46 versus 29.8 in the <35 group ($p<0.001$). Most recent follow-up range of motion in the BMI>40 group was 0.4-112.9°. In the BMI<35 group, it was 0.3-116.5° ($p=0.791$, 0.149 respectively). Most recent Knee Society Scores in the BMI>40 group were 92.1 and 61 for function, versus 91.8 and 73.8 for function in the BMI<35 group ($p=0.903$, 0.004 respectively). There were 3 deep infections in the BMI>40 group and 1 in the BMI<35 group ($p=0.310$). The morbidly obese group had 1 additional revision for aseptic loosening and instability versus two in the cohort ($p=0.560$). The BMI>40 group had 10 other complications not requiring revision of components, including 7 surgical and 3 medical. The BMI<35 group had 13, including 9 surgical and 4 medical ($p=0.495$).

DISCUSSION AND CONCLUSION: Although there was an increased trend for deep infection in the BMI>40 group, there were no significant differences in terms of complications, revisions, or postoperative range of motion between the two groups. The use of cementless TKA in morbidly obese patients with the potential of durable long-term biologic fixation seems promising based on our study. Long-term data will help determine the efficacy of cementless TKA in this difficult group of patients.

Lateral-Pivot Motion in Early Flexion Simulating Native Knee Kinematics Results in Better Outcomes After Total Knee Arthroplasty

Abstract ID: Paper 192

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INTRODUCTION: Modern kinematic research has determined that native ACL-intact knees exhibit lateral pivot motion in early flexion. The purpose of this study was to determine if intraoperative kinematic patterns of lateral-pivot motion in early flexion and medial pivot in greater flexion result in superior outcomes after TKA.

METHODS: A retrospective review was performed of consecutive primary TKAs by two surgeons. Sensor-embedded trials determined kinematic patterns intraoperatively. Medial and lateral condyle contact points were recorded at 0°, 45°, and 90° of flexion. The contact points created vector intersections and centers of rotation, designated medial-pivot, lateral-pivot or translation based on accepted criteria. TKAs simulating native knee kinematics were categorized with lateral-pivot kinematics in early flexion from 0-45° and medial-pivot patterns from 45-90°. Modern Knee Society, EQ-5D, and UCLA Scores were measured preoperatively and at one-year follow-up.

RESULTS: 152 TKAs were included in the analysis. Nine (6%) were lost to minimum one-year follow-up. 75% of patients were female. Mean age and BMI were 63.6 years and 33.8, respectively. 23% of TKA's exhibited native knee kinematics of lateral-pivot in early flexion and medial-pivot in greater flexion. TKAs with this kinematic pattern demonstrated greater improvement in both Knee Society objective scores ($p = 0.009$) and function scores ($p = 0.022$) compared to other patterns. There was no difference in EQ5D or UCLA scores between kinematic patterns ($p > 0.15$) with numbers available.

CONCLUSION: TKAs with lateral pivot kinematics in early flexion, as observed in native knees during walking, and medial-pivot in higher flexion achieve greater improvement in outcomes compared to patients with other kinematic patterns. This may explain why unicompartmental arthroplasty patients experience higher satisfaction and a more normal feeling knee. Further study of more complex TKA kinematic patterns that replicate native knee kinematics in various degrees of flexion and specific functional activities is warranted.

How Do Preoperative Medications Influence Patient Outcomes After Total Joint Arthroplasty?

Abstract ID: Paper 194

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BACKGROUND: As the U.S. population grows older, the annual demand for total joint arthroplasty (TJA) will increase. Elderly patients often have more complicated medical histories and require more medications. Recent changes in reimbursement have placed pressure on surgeons and hospital systems to identify patients that will require a higher level of resources. In 2012, our prospective database was formed with BCBS of Michigan to identifying patterns of care and improve quality within the state. The purpose of this study was to analyze patient preoperative medication type and quantity as predictors of outcomes after total joint arthroplasty.

METHODS: Using our hospital system database, we reviewed all elective primary total joint arthroplasty (TJA) patients from 2012 through 2015. Patients were excluded if they had revision surgery, TJA for a fracture, or had less than a 90-day follow up. Data were collected on patient's preoperative medications within 30 days of surgery. Medications were categorized as: antiplatelet, antimicrobial, anticoagulant, narcotic, steroid, insulin, or oral diabetes medication. Outcome measures included: hospital length of stay (LOS), discharge destination, and 90-day readmission to our hospital system. Univariate and multivariable regression analysis was performed.

RESULTS: 3,959 patients fit out inclusion/exclusion criteria (2,741 TKA and 1,218 THA). The average LOS after arthroplasty was 2.34 days. Eighty percent (3163) of our patients were discharged home. The average number of preoperative medications was 0.88. TKA patients discharged to an extended care facility (ECF) were taking significantly more medications (1.13 vs. 0.80 $p<0.0001$). The same relationship was true of THA patients (1.18 vs 0.83 $P<0.001$). Patients readmitted averaged 1.0 medications while those without averaged 0.85 ($P<0.01$). Multivariable regression analysis of TKA patients showed more discharges to ECFs in patients taking: narcotics, steroids, insulin, and oral diabetes medications. Patients taking anticoagulants, narcotics, and insulin had a greater readmission rate. In the THA population, narcotics and oral diabetes medications were predictors of discharge to ECF. Antiplatelet users showed significantly more readmissions. Liner regression showed a significant correlation between the number of preoperative medications and an increased LOS.

CONCLUSIONS: Patients taking more preoperative medications were discharged to an extended care facility more frequently after THA or TKA and showed an increased readmission rate. Narcotics and diabetic medications showed the greatest increase in frequency of discharge to ECF. Length of stay was correlated with increased number of medications. Number and type of preoperative medications can be used as predictors of outcome after arthroplasty surgery.

Improved Early Postoperative Range of Motion in Total Knee Arthroplasty Using Tranexamic Acid: A Retrospective Analysis

Abstract ID: Paper 195

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Abstract:

INTRODUCTION: The use of tranexamic acid (TXA) in total knee arthroplasty to decrease bleeding and transfusion rates has become a common practice. Recent literature has demonstrated a reduction in postoperative knee swelling and drain output when using TXA. Few have evaluated this effect or quantified the reduction in swelling and postoperative range of motion. Our purpose is to analyze preoperative and postoperative range of motion following total knee arthroplasty in patients who received TXA compared to a control group. We hypothesize that patients treated with TXA will have improved early postoperative range of motion when compared to controls.

METHODS: A retrospective chart review was performed evaluating records of patients who underwent total knee arthroplasty between 2010 to 2012 performed by a single orthopedic surgeon. Patients were stratified into 3 cohorts by route of TXA administration including intravenous, topical, and a control group. Dependent variables analyzed included extension, flexion, and total arc range of motion (ROM) on each postoperative day (0, 1, and 2), average extension, flexion, and total arc ROM across all three postoperative days, as well as pre- to postoperative differences in extension, flexion, and total arc ROM. Demographic data including age, sex, smoking status, severe complications, and preoperative range of motion were recorded for each patient.

RESULTS: A total of 174 patients were included for analysis, 75 controls and 99 receiving TXA. The average values in degrees across the hospitalization for extension, flexion, and total arc ROM in the treatment group were 0.313, 116.898, and 116.585, and for the control group 1.733, 94.293, and 92.560, respectively. A significant difference was found between the treatment groups and the control for all variables (for each, $P \leq 0.002$), except for the pre-/postoperative difference in extension ($P = 0.427$). There were no significant differences between the IV and topical TXA treatment groups (for each, $P \geq 0.558$). A multivariate analysis demonstrated no significant difference between the groups for demographic variables or complications.

DISCUSSION AND CONCLUSION: The use of tranexamic acid may impact early postoperative range of motion following total knee arthroplasty.

Intra-Articular Knee Injections and the Incidence of Periprosthetic Joint Infection Following Total Knee Arthroplasty

Abstract ID: Paper 196

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INTRODUCTION: The relationship between the number and timing of intra-articular injections and periprosthetic joint infection (PJI) following total knee arthroplasty (TKA) remains controversial. Recent data suggests the administration of injections prior to TKA increases the incidence of PJI, but this result is based on national and insurance claim databases with known limitations. The purpose of this study was to determine the relationship between knee injections and PJI following TKA.

METHODS: Using billing codes, 398 patients who underwent TKA with history of at least one ipsilateral intraarticular knee corticosteroid or viscosupplementation injection were identified from a single surgeon's database. An additional cohort of TKA patients with self reported history of no lifetime injections and no billed clinic injections was identified. Records were retrospectively reviewed for patient comorbidities, number/timing of injections, and periprosthetic joint infection. Cohorts were stratified based on number of lifetime injections, number of injections in the year prior to surgery, and timing of last injection prior to surgery for analysis.

RESULTS: 442 patients (27.4% male) with a mean BMI of 35.8 +/- 9.0 kg/m^2 and mean age of 64.7 +/- 11.0 years were identified. 44 (10.0%) had no lifetime history of injections prior to TKA. There was no association between the incidence of PJI and number of lifetime injections ($p=0.488$), number of injections in the year prior to surgery ($p=0.825$), and timing of the most recent injection prior to surgery ($p=0.573$).

CONCLUSION: In a detailed analysis of a single surgeon's database, the timing/number of injections prior to TKA demonstrated no association with PJI. This data suggests that focused studies on individual orthopedic centers may provide further evidence for the use of intra-articular injections prior to TKA. While each individual study may be underpowered, a meta-analysis may prove less susceptible to confounding data than results generated from large national datasets.

MAOA BREAKOUT SESSION #14
SHOULDER
April 22, 2017

Long-Term Outcomes of Humeral Head Replacement for the Treatment of Osteoarthritis: A Report of 44 Arthroplasties with Minimum 10-Year Follow-Up

Abstract ID: Paper 197

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BACKGROUND: We have previously demonstrated mixed results after humeral head replacement (HHR) for osteoarthritis at short- and medium-term follow-up intervals. The purpose of this study was to expand on our previous studies to define the long-term outcomes (minimum 10 years) of HHR for the treatment of osteoarthritis.

METHODS: Between 1978 and 1997, 60 patients underwent HHR for osteoarthritis at our institution. We previously reported on 51 of these at a minimum of 5 years of follow-up. In the interim, 7 shoulders passed away prior to 10 years postoperatively. Therefore, 44 shoulders in 42 patients who had been followed for a minimum of 10 years were included in this study, at a mean clinical follow-up of 17 years (range, 10- 30). The average age at the time of surgery was 58 (range, 37-77) and 39% of the shoulders were female. Twelve out of 44 were manual laborers, while office workers and homemakers comprised the remainder of the group. Of this group, 31 shoulders had radiographic follow-up beyond 5 years, at a mean of 11.1 years (range, 5-21).

RESULTS: Patients experienced significant pain relief postoperatively, that was maintained over the long-term follow-up ($p<0.01$), with a subgroup of 11 patients reporting persistent moderate or severe pain. When compared to preoperatively, patients also maintained significant increases in shoulder abduction (<0.01), external rotation (<0.01), and Modified Neer Scores (<0.01). 64% of patients were satisfied with their function at last clinical follow-up. Ten out of 44 (22.7%) shoulders underwent revision surgery, predominantly for glenoid arthrosis (n=6). In the 31 shoulders with 5 years of radiographic follow-up, Kaplan-Meier Survival analysis demonstrated moderate to severe glenoid erosion in 50% at 5 years, which increased to 59% at 15 years, and 88% at 20 years. Increasing patient age at the time of surgery was the only significant risk factor for moderate or severe glenoid erosion ($p=0.03$).

CONCLUSIONS: Humeral Head Replacement remains a partially successful operation for osteoarthritis at long-term follow-up. However, there is a high rate of glenoid erosion after 10 years, many requiring revision surgery. With this high rate of glenoid erosion over long-term follow-up, surgeons should carefully consider the indications of HHR for the right patient. However, in shoulders not revised, patients' function and pain relief do not deteriorate over long-term follow-up.

Early Follow-Up of Total Shoulder Arthroplasty in Patients Under 65 Years of Age vs. Older Than 75

Abstract ID: Paper 198

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BACKGROUND: Anatomic total shoulder arthroplasty (aTSA) has shown predictable long-term results in treating glenohumeral osteoarthritis in elderly patients. However, the difference in postoperative outcomes between younger patients and the elderly has not been well defined. The purpose of this study was to compare early aTSA outcomes in patients younger than 65 years of age versus patients older than 75.

METHODS: A multi-center prospective cohort of 365 patients (262 < 65 years, 103 > 75 years) treated with aTSA for glenohumeral osteoarthritis was analyzed. Mean follow-up was 44.8 months in the <65 year group and 44.0 months in the >75 year group. Outcomes were assessed using SST, UCLA, ASES, Constant, and SPADI metrics; active abduction, forward flexion, and internal/external rotation were also measured to quantify function. A two-tailed, unpaired t-test identified differences ($p < .05$) in preoperative, postoperative, and pre-to-post improvements.

RESULTS: Patients under 65 years of age with glenohumeral osteoarthritis had increased preoperative constant scores (37 versus 32), active abduction (82.4 ± 27.7 versus 72.2 ± 27.6), and active forward elevation (98.8 ± 30.1 versus 87.6 ± 31.8), when compared to patients over 75 years; $p = .017$, $p = .011$, $p = .011$), respectively. Following surgery, patients over 75 years of age had increased improvement in active forward flexion (59.3 ± 35.9 versus 47.3 ± 36.7) and abduction (59 ± 36.8 versus 40.4 ± 37.5) when compared to those less than 65 years of age; $p = .024$, $p < .001$, respectively. Elderly patients also saw a more significant improvement in Constant scores (41 versus 35) and UCLA scores (54 versus 49); $p = .046$, $p = .003$, respectively. There were no significant differences in overall postoperative outcomes, or improvement of active internal/external shoulder rotation, SST, and ASES scores. Both groups reported high satisfaction with their procedure.

DISCUSSION AND CONCLUSION: This study found that patients under 65 years of age with glenohumeral arthritis have increased preoperative functional scores and active range of motion (ROM) when compared to elderly patients. However, after undergoing an aTSA, these same patients appreciate less improvement of functional scores and ROM when compared to patients over 75 years of age. Patients should be informed that overall function and ROM are not altered by the age one undergoes aTSA; however, younger patients may expect less improvement from preoperative levels.

Early Outcomes of Anatomic Total Shoulder Arthroplasty According to Sex

Abstract ID: Paper 199

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BACKGROUND: Anatomic total shoulder arthroplasty (aTSA) provides reproducible results in treating glenohumeral osteoarthritis and has seen increased rates of usage in the recent years. While the same implant is used with males and females, there is limited data in the literature with regard to differences in outcomes between genders.

METHODS: A multi-center prospective cohort of 669 patients (372 females, 297 males) treated with aTSA for glenohumeral osteoarthritis from 2005 to 2013 was retrospectively analyzed. Mean follow-up was 44.4 months in females and 44.6 months in males. Outcomes were assessed using ASES, SPADI, Constant, UCLA, and SST scores; active abduction, forward flexion, and internal/external rotation were also measured to quantify function. A two-tailed, unpaired t-test identified differences ($p < .05$) in preoperative, postoperative, and pre-to-post improvements.

RESULTS: Female patients underwent aTSA at a significantly older age (68.1 years) than the average age of males (64.7); $p < .001$. Female patients started with lower preoperative outcome scores when compared to males; ASES (33.8 versus 39.2; $p < .001$), SPADI (88.9 versus 79.5; $p < .001$), Constant score (35.0 versus 38.7; $p = .004$), UCLA score (13.2 versus 14.8; $p < .001$), SST (3.0 versus 4.3; $p < .001$) and daily pain (6.5 versus 6.0; $p = .04$). The only difference in preoperative function was found in active abduction, in which males displayed greater abduction (84 ± 27.7 degrees) when compared to females (79 ± 27.8 degrees); $p = .04$. Following surgery, both groups reported high satisfaction with their procedures. Female patients maintained lower overall outcome scores with regards to ASES score (82.1 versus 87.2; $p < .001$), SPADI score (21.2 versus 12.7; $p < .001$), Constant score (68.4 versus 73.7; $p < .001$), UCLA score (29.8 versus 30.9; $p = .02$) and SST score (10.0 versus 10.8; $p < .001$). There were no clinically significant differences in postoperative range of motion (ROM) between sexes. When evaluating improvement from preoperative values, we found no statistical differences between the groups.

DISCUSSION AND CONCLUSION: This study found that female patients undergo aTSA at a later age than male patients, and begin with worse shoulder abduction and outcome scores. Although female patients maintain lower postoperative outcomes scores, there was no significant difference in absolute improvement from preoperative function and outcomes when comparing females and males. This suggests that there is no difference in absolute functional improvement or outcomes based on gender when undergoing aTSA.

Preoperative Narcotic Use Predicts Markedly Inferior Outcomes Following Anatomic Total Shoulder Arthroplasty

Abstract ID: Paper 200

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INTRODUCTION: Total shoulder arthroplasty (TSA) is commonly performed for symptomatic glenohumeral arthritis. Preoperative narcotic use has recently been examined as a possible cause of poor patient outcomes. We proposed to study a patient population undergoing primary anatomic total shoulder arthroplasty to determine if chronic use of preoperative narcotics adversely affected two-year patient outcomes.

METHODS AND MATERIALS: After Institutional Review Board approval, 79 shoulders undergoing primary anatomic TSA were included. Patients were evaluated preoperatively and postoperatively at a minimum of two years. Patients were evaluated using American Shoulder and Elbow Society (ASES) scores, Visual Analog pain scores (VAS), active shoulder range of motion, and strength testing. Complications data was also compiled. Radiographs from the most recent follow-up at a minimum of 2 years were analyzed for radiolucencies.

Paired t-tests and Fisher-exact tests were used to determine statistical differences between groups. Differences with $p<0.05$ were considered statistically significant.

RESULTS: Twenty-eight shoulders taking narcotic pain medication for a minimum of 3 months prior to surgery, and 51 shoulders who were not taking narcotics preoperatively, were included. The average duration of follow-up was 31.5 months for the non-narcotic group and 34.0 months for the narcotic group ($p=0.32$). There were also no significant differences between the groups with respect to demographic factors.

The average ASES score improved from 30.7 to 60.4 in the narcotic group, and from 45 to 88.7 in the non-narcotic group. The differences in final ASES score and in the amount of improvement between groups were both statistically significant ($p<0.01$, $p=0.01$ respectively). The average VAS score at most recent follow-up was 0.4 in the non-narcotic group 2.6 in the narcotic group ($p<0.01$). Statistically significant negative differences were found for the narcotic group regarding active forward flexion, external rotation, flexion strength, internal rotation strength and external rotation strength ($p\leq0.01$). Radiographic analysis found no difference between groups with regard to the number radiolucencies. There were 4 (14%) complications in the narcotic group and 1 (2%) in the non-narcotic group ($p=0.05$).

CONCLUSION: These results demonstrate that patients taking chronic preoperative narcotics had markedly worse outcomes and a higher complication rate at two years versus those not taking narcotic medications. Moreover, patients taking preoperative narcotics demonstrated less improvement than those in the non-narcotic group, indicating they derive less benefit from the

intervention. We conclude that preoperative narcotic use may be considered a significant adverse risk factor in predictive modeling for total shoulder arthroplasty.

A Prospective Randomized Controlled Clinical Trial to Identify the Optimal Postoperative Pain Management in Shoulder Arthroplasty: Liposomal Bupivacaine vs. Continuous Peripheral Nerve Block

Abstract ID: Paper 202

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BACKGROUND: Shoulder arthroplasty is the fastest growing joint replacement surgery in the U.S. Continuous peripheral nerve catheters (CPNC) have significantly improved postoperative pain control compared to narcotics alone, and several studies have shown CPNC to be superior to single shot peripheral blocks. However, CPNCs are suboptimal in terms of cost efficiency and complications. Innovative long-acting liposomal bupivacaine promises to be a useful adjunct to multimodal postoperative pain management. The purpose of this study was assess the impact of liposomal bupivacaine (LB) compared to CPNC in terms of postoperative pain control and outcomes for shoulder arthroplasty.

METHODS: A prospective randomized controlled clinical trial compared 68 consecutive patients undergoing shoulder arthroplasty treated with multimodal pain management with traditional CPNC versus LB. The primary outcome measures included pain assessment every 2 hours after surgery and narcotic usage during the inpatient stay were recorded. Follow-up telephone surveys were conducted at 2 and 7 days to assess pain and narcotic usage. Follow-up postoperative assessments included patient reported functional outcome scores (PENN, ASES, and SSV scores) at 6 weeks, 3 months, and 6 months postoperatively. Linear regression models were created to analyze pain scores, narcotic usage, and functional outcome score trends and compared using ANOVA test.

RESULTS: The CPNC group consisted of 33 patients and the LB group had 30 patients. There was no significant difference in narcotic usage (measured in morphine-equivalents) and patient-reported pain scores within the first 24 hours postoperatively between groups ($p>0.05$). Postoperatively, there were no significant differences in total milligrams of equivalent morphine consumed in the first three days (CPNC =35.5 mg compared to 71 mg for LB group ($p=0.25$)) and time to first narcotic usage. There was no significant difference in length of stay between groups. There was a significant increased number of complications for the CPNC group compared to the LB ($p=0.05$). There was no significant difference in preoperative or postoperative patient-reported ASES, PENN, and SSV outcome scores between the groups ($p>0.05$).

CONCLUSION: From this study, liposomal bupivacaine plus single-shot peripheral nerve block appears to be equivalent to continuous interscalene peripheral nerve catheter in terms of postoperative pain relief, narcotic usage, length of stay, and time to rescue narcotic for shoulder arthroplasty patients. Our results demonstrate a lower complication rate and decreased cost for

liposomal bupivacaine over CPNC for postoperative pain relief after shoulder arthroplasty. Therefore, liposomal bupivacaine promises to be a useful adjunct for postoperative pain control.

Liposomal Bupivacaine Has Equivalent Pain Relief and Significantly Fewer Complications at Less Cost Compared to Indwelling Interscalene Catheter in Shoulder Arthroplasty

Abstract ID: Paper 203

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(Presented by Allen Ryves Moore, M.D., Memphis, TN)

BACKGROUND: Liposomal bupivacaine formulations have shown increased application in orthopedic hip and knee arthroplasty procedures. However, there is currently no published data on the pain control achieved with this treatment modality in shoulder arthroplasty. We proposed to compare postoperative pain levels, narcotic use, complication rates, and costs of liposomal bupivacaine (LBC) to indwelling interscalene catheter (ISC) in patients undergoing primary shoulder arthroplasty.

METHODS: Two hundred fourteen primary shoulder arthroplasties done by a single surgeon were included. One hundred and fifty-six patients were treated with an indwelling interscalene catheter that was kept in place for three to four days postoperatively. Fifty-eight patients were treated with an intraoperative liposomal bupivacaine injection that also included morphine, ketorolac, and 0.5% bupivacaine. Patient charts were reviewed for visual analog pain scores (VAS), oral morphine equivalent (OME) usage, major complications, and charges. Chi-squared tests were applied to determine differences between the two cohorts in regards to complications and two-tailed t-tests were used to compare VAS and OME usage. Differences with $p<0.05$ were considered statistically significant.

RESULTS: Mean VAS at 24 hours postoperative was 3.2 for the ISC group and 3.6 for the LBC group (p=0.39). Mean 2 week, 6 week, and 12 week VAS scores also were not significantly different between the two cohorts (2 week p=0.99, 6 week p=0.58, 12 week p=0.58). Average oral morphine equivalent consumption at 24 hours postoperative for the ISC cohort was 64.3 mg and 130.4 mg for the LBC cohort (p= 0.003). Total OME use at 12 weeks postoperative was not significantly different (p=0.47).

There were 20 major complications in the ISC group (12.8%), including respiratory distress, catheter incarceration, and recalcitrant brachial neuritis. There were 2 major complications (1 pulmonary embolism and 1 readmission for repeated falls) in the LMC group (3.4%, p=0.045).

The average charge for the LBC mixture was $304.40 per case while charges for ISC, including equipment and anesthesia fees, were $1,472.42.

CONCLUSION: Intraoperative LBC injection provided equivalent pain relief and a significantly decreased major complication rate in this study compared to indwelling ISC. While the LBC required almost twice as much oral morphine equivalent to attain the same level of pain relief at 24 hours, there was no significant difference in the cumulative amount of postoperative narcotic use. Cost analysis demonstrated LBC charges to be approximately $1168 less per case than

ISC.

LEVEL OF EVIDENCE: Level III, therapeutic

Tobacco Use Results in Inferior Outcomes After Anatomic Total Shoulder Arthroplasty

Abstract ID: Paper 204

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BACKGROUND: Tobacco use is linked to a number of adverse outcomes following orthopedic procedures. Smoking is a risk factor for postoperative complications in total hip/knee arthroplasty, trauma, and spinal fusion. However, little is known regarding its effect on shoulder arthroplasty outcomes. This study's purpose was to examine the impact of smoking on clinical and radiographic outcomes in patients following primary anatomic total shoulder arthroplasty.

METHODS: An IRB-approved, retrospective search of primary anatomic total shoulder arthroplasties performed at our institution was conducted. Patients were classified as nonsmokers, former smokers, or current smokers at the time of their surgery. Patients with at least two years of clinical and radiographic follow-up were included. Patients were assessed clinically with visual analog scores (VAS), American Shoulder and Elbow Surgeons (ASES) scores, Single Assessment Numeric Evaluation (SANE) scores, and range of motion testing. Complications data were obtained and postoperative radiographs were assessed for signs of loosening or mechanical failure. Statistical analysis was performed using Fisher's Exact tests and Kruskall Wallace tests using SAS software.

RESULTS: One hundred two patients (59 nonsmokers, 29 former smokers, and 14 current smokers) with a mean age of 67 years (range 30-88 years) and mean follow-up time of 36 months (range 24-67 months) were included. Smokers (age 58) were significantly younger than nonsmokers or former smokers (age 67 and age 70, respectively, p=0.004). There were no other significant differences between groups regarding gender, operative indication, comorbidities, laterality, or duration of follow-up.

The mean VAS pain score for smokers at final follow-up was 3.9, while pain scores for nonsmokers and former smokers averaged 1.3 and 1.0, respectively (p=0.04). ASES scores were 62 for smokers, 79 for nonsmokers, and 84 for former smokers (p=0.0007). The complication rate was 35.7% for smokers, 15.3% for nonsmokers, and 6.9% for former smokers (p=0.051). Complications included subscapularis failure, superior rotator cuff tear, arthrofibrosis, infection, and subacromial impingement. No significant differences between groups were found for range of motion, SANE score, reoperation rate, or periprosthetic radiolucency. Radiographically, no patient had significant component loosening.

CONCLUSIONS: Current smokers who underwent total shoulder arthroplasty had significantly worse pain, worse functional scores, and higher complication rates with at least 2 years follow-up. Former smokers and nonsmokers had similar results, suggesting that patients who quit smoking preoperatively can achieve improved outcomes. Smokers should be counseled regarding smoking cessation and their risk of inferior outcomes prior to total shoulder arthroplasty.

Radiographic and Clinical Survival in Total Shoulder Arthroplasty: Pegged Glenoid Components

Abstract ID: Paper 205

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INTRODUCTION: Loosening of the glenoid component is a primary reason for failure of an anatomic shoulder arthroplasty. Pegged glenoids may be superior to keeled components. This study evaluates mid-term radiographic and clinical failure in pegged glenoid components using a single implant, and identifies risk factors for radiographic loosening and clinical failure.

METHODS: 330 shoulder arthroplasties were implanted utilizing a cemented, all-polyethylene pegged glenoid component. Mean clinical follow-up was 7.2 years. 287 of these shoulders had preoperative, initial postoperative, and late postoperative radiographs, mean radiographic follow-up 7.0 years (minimum 4 years).

RESULTS: 120 of 287 glenoid components (42%) were considered loose based on radiographic evaluation. Four humeral components (1%) were considered loose. Component survival (Kaplan-Meier) free from radiographic failure at 5 and 10 years were 92% (95% CI) (89-95%) and 43% (95% CI) (36-52%). Severe preoperative glenoid erosion (Walch A2, B2, C) was a risk factor for radiographic failure (P = 0.01), as was patient age less than 65 years (P = 0.009). Use of a large glenoid component trended towards significance (P = 0.07). Glenoid component survival free from revision at 5 and 10 years for the 330 shoulders were 99% (95% CI) (98-100%) and 83% (95% CI) (76-89%).

CONCLUSION: Despite the predominant thinking that pegged glenoid components may be superior to keeled designs, long-term radiographic and clinical failure rates are markedly similar. Advanced preoperative glenoid erosion and younger patient age appear to be risk factors for radiographic loosening. Revision rates are slightly higher than in the keeled components, but remain relatively low.

Effects of Medicaid Payer Status on Outcomes and Follow-Up Reliability After Shoulder Arthroplasty

Abstract ID: Paper 206

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INTRODUCTION: Shoulder arthroplasties have increased 2.5 fold over the past decade and by 2030, their demand is expected to grow by 755% in patients over 55 years. Optimizing patient reported and functional outcomes following shoulder arthroplasty (SA) remains the goal, and it has been demonstrated in other total joint arthroplasty that socioeconomic and insurance type may be significant factors influencing these outcomes. Thus, the purpose of this study was to examine the outcomes and resource utilization associated with Medicaid payer status following shoulder arthroplasty in a single surgeon's practice.

METHODS: A retrospective review of 174 shoulder surgery patients treated by a single surgeon was performed to identify 50 patients treated with SA. Patients were stratified based on insurance type into two cohorts, Medicaid (M) (28 patients) and non-Medicaid (NM) (23 patients), with one patient having both insurance types. Baseline demographics, resource utilization, and outcomes were compared by insurance type. Pre- and postoperative patient-reported outcomes and functional scores were also compared between groups. Patient-reported outcomes included American Shoulder and Elbow Shoulder Score (ASES), the Penn Shoulder Score (PSS), and the Subjective Shoulder Value (SSV). A p-value of <0.05 was considered significant for all statistical analyses.

RESULTS: Medicaid patients were on average 12.3±13.9 years younger than non-Medicaid patients, but there were no other demographic differences between groups. There was also no significant difference in baseline scores between groups for ASES ($p=0.061$), PENN ($p=0.182$), or SSV ($p=0.156$). On average M group missed more postoperative follow-up visits (18%) compared to NM cohort (11%) ($p=0.135$).

Medicaid and non-Medicaid patients experienced significant improvement on all patient-reported outcomes ($p<0.05$); however, no statistical differences between cohorts were noted for ASES (64.9% vs. 59.1%) ($p=0.454$), PENN (62.6% vs. 53.0%) ($p=0.242$), or SSV measures (72.6% vs. 72.6%) ($p=0.999$). Both groups displayed excellent improvement for all range of motion measures (forward flexion average improvement=41.25°, external rotation average improvement=7.75° and abduction average improvement=43.88°) with no significant differences.

DISCUSSION: Our results are important for orthopedic surgeons to recognize when treating the expanding Medicaid population. Our results suggest that insurance status and socioeconomic factors do not appear to play a significant role in SA patient-reported or functional outcomes. Medicaid patients can expect equally successful recovery and satisfaction when undergoing a shoulder arthroplasty surgery. Even though physicians cite obstacles to servicing the Medicaid population, they can feel reassured that these patients may still be treated successfully with SA.

The Impact of Preoperative Opioid Use and Primary Payer Status on Outcomes After Arthroscopic Rotator Cuff Repair

Abstract ID: Paper 207

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INTRODUCTION: Preoperative opioid use has been correlated to suboptimal patient outcomes following total knee arthroplasty, shoulder arthroplasty, and spine surgery. Orthopedic surgeons are the third highest prescribers of opioid pain relievers in the United States, which leads to an often-frustrating cycle of complicated management for these patients. The rapidly expanding Medicaid population has been demonstrated to be at a greater risk of opioid abuse. The purpose of this study was to evaluate the impacts of preoperative opioid use and primary payer status on outcomes following arthroscopic rotator cuff repair (RCR).

METHODS: A retrospective review was performed to identify 79 patients who underwent arthroscopic RCRs with a minimum 3 months follow-up. 31 patients with a history of preoperative opioid use (> two weeks) (OU group) were compared to a control group of 48 patients without a history of preoperative opioid use (NOU group). Each cohort was further separated based on primary payer status into two subcategories: Medicaid and non-Medicaid patients. Pre- and postoperative patient-reported outcomes and functional scores were compared between groups.

RESULTS: Both cohorts significantly improved ($P < 0.05$) on all patient-reported shoulder scores; however, the NOU group demonstrated significantly better patient-reported outcome scores postoperatively (ASES mean=74.8, [$P = 0.003$]; PENN mean=72.4, [$P = 0.008$]; and SSV mean=77.4,]$P < 0.001$[), and the magnitude of change between the groups from the preoperative to postoperative assessment was significant ($P < 0.05$) for all outcomes measures except external rotation. Only the NOU group demonstrated significant improvement in range of motion measurements, including forward elevation ($P < 0.001$) and abduction ($P = 0.016$). Within the non-opioid cohort, both Medicaid and non-Medicaid groups demonstrated significant improvement in all patient-reported outcomes scores; however, non-Medicaid patients experienced greater functional improvement in abduction and external rotation ($P < 0.05$) compared to Medicaid patients. Within the opioid cohort, Medicaid patients reported significantly lower subjective shoulder scores ($P < 0.05$) when compared to non-Medicaid patients. Regardless of payer status, patients using opioids preoperatively did not demonstrate significant improvement in range of motion.

DISCUSSION: Our results demonstrate preoperative opioid use may have a greater impact on functional outcome scores than Medicaid payer status alone, and Medicaid payer status may have a greater impact on patient-reported outcomes than preoperative opioid use following arthroscopic RCR. This comprehensive analysis is highly valuable, given the increase in utilization of this procedure concomitant with an increase in opioid use for pain management of orthopaedic conditions.

A Prospective Evaluation of Predictors of Pain After Arthroscopic Rotator Cuff Repair (ARCR): Psychosocial Factors Have a Stronger Association Than Structural Factors

Abstract ID: Paper 208

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INTRODUCTION: The goal of this study is to prospectively evaluate which preoperative factors correlate with postoperative pain following ARCR. We hypothesized that non-structural factors, including metrics of psychological well-being and preoperative narcotic use, will correlate with higher pain levels postoperatively, while structural factors such as tear size will not be predictive.

METHODS: 99 patients scheduled for ARCR were prospectively enrolled and evenly distributed by tear size. Patient gender, age, occupation, smoking status, tear mechanism, tear characteristics on MRI, visual analogue scale (VAS) pain scores, narcotic usage, range of motion (ROM) by goniometry, and functional and psychological assessments through the ASES, SST, WORC, and RAND questionnaires were obtained preoperatively. VAS scores and ROM were collected postoperatively at 2 weeks, 6 weeks, 3 months, 6 months, and 1 year. The ASES, SST, WORC, and RAND questionnaires were repeated 1 year postoperatively. Correlation coefficients between preoperative factors and VAS pain scores were calculated.

RESULTS: The mean age was 56.4 years, and consisted of 54% males. There were 68% traumatic tears, 11% smokers, and 13% used narcotics preoperatively. ROM, VAS, ASES, and WORC scores all improved significantly from the preoperative to 1 year postoperative: 136° versus 164° in forward elevation ($p<0.001$); 55° versus 64° in external rotation ($p=0.005$); L3 versus T12 in internal rotation ($p<0.001$); 4.2 versus 0.7 for VAS ($p<0.001$); 42.3 versus 91.9 for ASES ($p<0.001$); and 88.7 versus 39.6 for WORC ($p<0.001$). The following factors correlated with increased pain scores at 1 year: preoperative narcotic use, higher preoperative VAS, and lower scores on the WORC index, WORC emotion section and RAND emotion section.

DISCUSSION: Our data shows that the factors most predictive of persistent pain after ARCR are psychosocial characteristics, including poor performance on validated measures of emotional well-being. Demographic and tear-specific structural factors did not correlate with postoperative pain scores. This is in line with recent studies that have shown that non-structural factors such as mental health are more influential than structural factors in predicting pain in patients with shoulder pathology. The ability to predict which patients will report persistent pain after ARCR is of great interest in the current healthcare climate, where quality of care assessments and reimbursement are linked to patient satisfaction. We see an opportunity for intervention through preoperative counseling to set appropriate patient expectations, which could lead to improved patient satisfaction.

A Biomechanical Comparison of Subscapularis Repair Techniques in Total Shoulder Arthroplasty: Lesser Tuberosity Osteotomy vs. Subperiosteal Peel

Abstract ID: Paper 209

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BACKGROUND: Subscapularis repair failure after shoulder arthroplasty remains a concern. The subscapularis peel (SP) and the lesser tuberosity osteotomy (LTO) are two common techniques that preserve the subscapularis tendon. While previous biomechanical studies have suggested that there is higher resistance to failure in the LTO, clinical studies have demonstrated no difference in repair failure or tendon healing between the two techniques.

HYPOTHESIS: We hypothesized that there would be no significant difference in repair strength between the SP and LTO techniques with biomechanical testing.

METHODS: Eleven matched cadaver shoulders were separated into 2 groups: 6 SP and 5 LTOs. After initial loading for 3000 cycles, the specimens were incrementally loaded to 450 ± 50 N, or catastrophic failure. Repair gapping was measured after cyclical loading and fatigue life was analyzed after incremental loading.

RESULTS: There was no significant difference in mean repair gapping between the SP group (2.40 mm ± 0.36; mean ± SD) and the LTO group (3.10 mm ± 2.93); P = .57. There was also no difference in mean number of cycles to failure (6773 vs. 6018) and mean load to failure (350 ± 90N vs. 313 ± 78N) between the SP and LTO techniques; P = .20 and P = .58 respectively.

CONCLUSION: No significant differences were found in repair gapping, fatigue failure, and load to failure when comparing the SP and LTO repairs. These findings suggest that initial fixation properties between the two constructs are similar in vitro. Clinical research is needed to determine the effects of bony and soft tissue healing on construct durability in vivo.

Trends and Costs Associated with Open vs. Arthroscopic Rotator Cuff Repair

Abstract ID: Paper 210

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BACKGROUND: Surgical repair of rotator cuff (RTC) tears is performed using open/mini-open repair or arthroscopic procedures. Our purpose was to evaluate trends in frequency and cost of open and arthroscopic RTC repair in the United States and describe tendencies in treatment across gender, age and geographic region. We hypothesized that surgeons are more likely to perform arthroscopic RTC repair, with similar trends across the U.S., with an increase in per patient average cost (PPAC).

METHODS: All patients who underwent RTC repair between January 2007-June 2015 were identified by Current Procedural Terminology (CPT) codes in a national insurance database (Humana), with open acute repair (CPT 23410), open chronic repair (CPT 23412), and arthroscopic (29827) techniques. The year, age, gender, and geographic region were collected. Chi-square test determined whether the proportion of arthroscopic surgeries differed between gender or regions; logistic regression determined whether this differed from 2007-2015. Wilcoxon Rank Sum Test compared differences in PPAC between open versus arthroscopic procedures.

RESULTS: Between 2007-2015, 54,740 patients underwent RTC repair; 68% arthroscopic and 32% open. Male patients accounted for 52% of repairs. Age groups with the highest frequency of RTC repairs were 65-74 years. The proportion of open RTC repair increased with increasing patient age ($p<0.0001$). The incidence of arthroscopic RTC repair increased from 56.9% in 2007 to 75.1% in 2015 (OR=2.29, 95% CI=2.09-2.50); incidence of open RTC repair decreased from 43.1% in 2007 to 24.9% in 2015 (OR=0.44, 95% CI=0.40-0.48). Overall trend was 188% increase in total RTC repairs from 2007-2015. There was no significant difference between men and women in proportion of arthroscopic or open surgeries ($p=0.22$). Arthroscopic repair was performed more frequently than open repair in all regions ($p<0.0001$). The proportion of arthroscopic RTC repair was higher in the south (70.9%) compared to other regions (Midwest [62.7%, $p<0.0001$], Northeast [66.1%, $p=0.0009$], West [65.5%, $p<0.0001$]). PPAC was significantly higher for arthroscopic procedures ($p=0.0004$) and increased over time ($1,846 in 2007 vs. $2,296 in 2015 for open; $2,378 in 2007 vs. $3,410 in 2015 for arthroscopic).

CONCLUSIONS: Analysis of RTC repair using Humana database revealed that arthroscopic RTC surgery predominates (>75%), and continues to increase. With increasing age, there was an increase in the proportion of open repair. There was no difference in regard to gender and RTC repair. The majority of RTC repairs were performed between ages 65-69. From 2007-2015, PPAC for arthroscopic RTC repair was significantly higher compared to open procedure.

Effects of Medicaid Payer Status on Outcomes and Follow-Up Reliability Following Rotator Cuff Repair

Abstract ID: Paper 211

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INTRODUCTION: Previous reports suggest that outcomes following rotator cuff repair (RCR) are affected by tear size, chronicity, age, and smoking status; however, payer status has not been examined in this patient population. Low socioeconomic status and Medicaid insurance as a primary payer have been shown to influence resource utilization and risk-adjusted outcomes for total joint arthroplasty. Following the expansion of Medicaid, it is imperative that we research the effect of payer status on outcomes for a common orthopedic procedures such as RCR. The purpose of this study is to identify the effect of Medicaid payer status on outcomes for RCR.

METHODS: A retrospective review of 174 shoulder surgery patients treated by a single surgeon was reviewed to identify 61 patients who underwent RCR. Patients were stratified based on insurance type into two cohorts: 31 Medicaid patients (Group 1) and 30 non-Medicaid patients (Group 2). Baseline demographics, resource utilization, and outcomes were compared by insurance type. Pre- and postoperative patient-reported outcomes and functional scores were also compared between groups. Patient-reported outcome scores included the American Shoulder and Elbow Surgeons Score (ASES), the Penn Shoulder Score (PSS), and the Subjective Shoulder Value (SSV). A p-value of <0.05 was considered significant for all statistical analyses.

RESULTS: Medicaid patients were on average 5.1 ± 11.09 years younger than non-Medicaid patients, but there were no other demographic differences between groups. There was also no significant difference in baseline scores between groups for ASES ($p=0.109$), PENN $p=0.311$), or SSV ($p=0.375$). Group 1 on average missed more postoperative follow-up visits (23%) compared to Group 2 (18%) ($p=0.414$).

Both groups experienced significant improvement on all patient-reported outcomes; however, non-Medicaid patients displayed significantly higher absolute postoperative scores for ASES (67.5% vs. 51.3%) ($p=0.033$), PENN (67.2% vs. 52.5%) ($p=0.034$), and SSV (74.8% vs. 60.7%) ($p=0.032$). Both groups demonstrated excellent improvements for all range of motion measures (forward flexion average improvement = 24.56°, external rotation average improvement = 3.36° and abduction average improvement = 19.82°).

DISCUSSION: Our results are vital for physicians treating the expanded coverage of millions of Medicaid patients. Despite a slightly higher rate of noncompliance with follow-up, overall our results suggest that Medicaid patients can expect excellent functional outcomes and significant improvement in pain after a RCR. Medicaid patients should not, however, expect to have the same level of patient reported satisfaction or outcomes compared to the non-Medicaid insured population.

Responsiveness of Patient Reported Outcome Scores After Rotator Cuff Repair: Which Score is Best?

Abstract ID: Paper 212

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OBJECTIVES: Patient reported outcomes (PROs) are increasingly used in orthopedics as a tool to objectively assess subjective data and provide a sense of responsiveness to treatment. Unfortunately, several challenges exist in obtaining PROs due to logistical, administrative, and financial challenges; one main challenge is the lack of consensus regarding the optimal PRO scores to administer. The purpose of this study was to evaluate the utilization and responsiveness of PROs reported in the literature after rotator cuff repair.

METHODS: We performed a systematic review of the PubMed, SportDiscus, Cochrane, and CINHAHL databases according to PRISMA guidelines to identify studies published in the last 10 years which reported PROs after rotator cuff repair. The specific PROs utilized, number of patients, mean follow-up time, and preoperative and postoperative means and standard deviations were recorded for each article, when available. For studies including preoperative and postoperative means and standard deviations of two or more PROs, the comparative responsiveness of each PRO was assessed using relative efficiency (RE).

RESULTS: After full-text review of 238 rotator cuff articles, 82 studies met criteria for final inclusion with 25 different PROs utilized in the included studies. The most commonly utilized PRO scores were the Constant (50 studies), VAS-pain (44), ASES (39), UCLA (20), and DASH (13). Responsiveness of the five most common PRO scores was evaluated with a subset of 28 studies that reported pre- and postoperative means and standard deviations for two or more PROs. The ASES was found to be more responsive than the Constant (RE=1.94), VAS-pain (RE=1.54), UCLA (RE=1.24), and DASH (RE=1.35) scores. The Constant score - the most frequent PRO utilized by the clinical studies - was less responsive than the ASES (RE=0.52), VAS-Pain (RE=0.72), and DASH (RE=0.91) scores.

CONCLUSIONS: When considering which PRO tools to use, providers must not only consider the psychometric properties of the tool, but also the ease and time required to complete, ability to be completed solely by the patient, and the potential for the patient to complete the assessment remotely. Despite being frequently used in the research community, the Constant score may be less clinically useful as it was less responsive and requires subjective patient-provided data as well as objective strength and ROM data gathered by the clinician. In contrast, the ASES score was highly responsive following rotator cuff repair and requires only subjective patient input.

The Impact of Cardiovascular Risk Factors on Intramuscular Fat Infiltration and Atrophy in Patients with Rotator Cuff Tears: A Preliminary Study

Abstract ID: Paper 213

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PURPOSE: Cardiovascular risk factors – smoking, hypertension, dyslipidemia – are associated with both incidence and size of rotator cuff tears (RCT). Rotator cuff muscle degeneration is a predictor of patient-reported outcomes following surgical repair. The precise impact of cardiovascular risk factors on muscle degeneration is unknown and may be valuable in management of RCT. The purpose of this study is to evaluate the effect of cardiovascular risk factors and other comorbidities on the magnitude of rotator cuff muscle fat infiltration and atrophy in patients with RCT.

MATERIALS/METHODS: Forty-seven consecutive patients with rotator cuff pathology were included. A musculoskeletal radiologist, blinded to surgeon diagnosis, retrospectively evaluated each MRI to determine the size of a rotator cuff tear. Dixon two-point sequences were used to quantify intramuscular fat (percent) in regions representing the supraspinatus (SS), infraspinatus/teres minor (IS), and the subscapularis (SC) as well as the supraspinous outlet (SP). All sagittal oblique images from the glenoid to the medial border of the scapula were segmented and analyzed. Mean percent fat and the volume of each muscle was calculated. The volume of each muscles was expressed as a ratio to the supraspinous fossa (ratio) to determine atrophy. Smoking status and diagnoses of hypertension and hyperlipidemia were recorded. Age-adjusted Charlson comorbidity index was calculated for each patient. Independent t-tests were used to compare mean percent fat and muscle atrophy in patients with hypertension, hyperlipidemia, and smoking history. The relationships between the Charlson comorbidity index and percent fat and muscle atrophy were determined using Pearson correlations.

RESULTS: Patients with hypertension had higher percent fat in the SS (8.5%; p=0.004), IF (7.8%; p = 0.003), and SC (4.2%; p = 0.007), but no significant differences in atrophy. Patients with hyperlipidemia had no significant differences in percent fat or atrophy between groups. Current/former smokers had greater percent fat in the SS (7.2%; p=0.025), IF (6.0%; p=0.041), and SC (3.5%; 0.036%), but no significant differences in atrophy. There were significant moderate positive linear relationships between age-adjusted Charlson index and percent fat in the SS (p=0.0251; r=0.334) and SC (p=0.0238; r=0.337), but only a trend towards a significant positive linear relationship in the IF (p=0.0504; r=0.293).

CONCLUSIONS: Risk factors associated with cardiovascular disease, specifically a history of smoking and hypertension, appear to increase intramuscular fat infiltration in patients with RCT. Other co-morbidities do not appear to have the same influence.

Revision to a Reverse Shoulder Arthroplasty in Patients Older Than 80 Years: Complications and Outcomes

Abstract ID: Paper 214

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INTRODUCTION: By the time patients with a failed shoulder arthroplasty require revision, a substantial number are older than 80. The safety and efficacy of revision arthroplasty in this elderly population is largely unknown and needs to be considered when contemplating whether these patients are too frail for revision surgery. The purpose of this study was to report the mortality, morbidity, complications, reoperations, and outcomes of revision to a reverse shoulder arthroplasty (RSA) in patients 80 years or older.

METHODS: Thirty-eight patients who were over 80 years old (83.7±2.8 years) underwent revision to a reverse arthroplasty and were followed for a minimum of 2 years or until revision/death (mean follow-up 28.4, range 1-77 months). Thirty-one (82%) patients had a minimum follow-up of 2 years.

RESULTS: Reverse arthroplasty resulted in substantial improvements in pain and function. Overall, there were 11 (35%) excellent, 9 (30%) satisfactory, and 11 (35%) unsatisfactory results. Range of motion increased after revision in forward flexion (FF) by 55° (preoperative mean 55°, postoperative mean 110°, $p<0.0001$) and external rotation (ER) by 17° (preoperative mean 16°, postoperative mean 33°, $p<0.0001$). The 90-day mortality rate was 2.6% (one patient), but the total mortality was 10 (26%) patients at a median (range) time of 46 (1-93) months. Medical complications were observed in three patients (8%), including pneumonia, urinary tract infection, and stroke. Postoperative anemia was common (eight patients, 21%), but only one patient required transfusion. Surgical complications included glenoid loosening (three, 10%), component dissociation (one, 3.3%), and deep infection (one, 3.3%). All patients with surgical complications required reoperation (five, 16%). Diabetes mellitus and congestive heart failure had a negative effect on surgical complications ($p<0.05$).

CONCLUSION: Revision to RSA is relatively safe (2.6% and 8% of 90-day mortality and morbidity, respectively) and effective in patients over the age of 80 years. Revision arthroplasty improved range of motion with a reoperation rate of 16% in this specific population. Diabetes mellitus and congestive heart failure were the main comorbidities associated with a worse outcome.

Reverse Shoulder Arthroplasty in Patients with Os Acromiale

Abstract ID: Paper 215

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INTRODUCTION: A number of individuals with end-stage cuff tear arthropathy will present with an os acromiale. Since reverse shoulder arthroplasty (RSA) increases deltoid tension, theoretically the unfused portion of the acromion could displace after the procedure, become symptomatic, or compromise the mechanical advantage of the deltoid. The purpose of this study was to determine the outcome and complications of primary RSA in patients with radiographic evidence of an os acromiale.

METHODS: Between 2005 and 2014, 25 shoulders that underwent primary RSA also had an os acromiale confirmed by plain radiographs and advanced imaging. The os acromiale was classified pre-acromion (3), meso-acromion (20), and meta-acromion (2). All patients were followed for a minimum of 2 years or until reoperation. Mean follow-up time was 26.3 (range, 1-63) months. Outcomes included pain scores, range of motion, patient satisfaction, modified Neer ratings, ASES scores, and radiographic outcomes, including migration or tilt of the os acromiale.

RESULTS: Pain scores improved in all shoulders ($p < 0.0001$). Elevation improved from 57° to 124° ($p < 0.001$), external rotation improved from 16° to 46° ($p < 0.001$), and internal rotation improved from an ability of the thumb to reach the posterior ileum to L4 ($p = 0.01$). The mean ASES score was 65.9 ± 13.2. Six patients received an unsatisfactory modified Neer rating. Two of these patients had greater than moderate pain, while 1 had limitation in elevation. The remaining 3 patients underwent reoperation. Two underwent successful open reduction for dislocation at 1 and 2 months postoperatively. The third patient complained of pain localized to the unfused acromion and underwent excision of the os acromiale at 6 months postoperatively with complete resolution of symptoms. There was no radiographic evidence of component loosening. Scapular notching was noted in 10 (40%) shoulders, and was grade 1 in 5, grade 2 in 4, and grade 3 in 1. Tilting of the os acromiale was noted on the immediate postoperative radiograph of 9 shoulders (36%). There was no statistically significant difference between those with or without tilting in regards to pain, range of motion, satisfaction, modified Neer result rating, ASES scores, or reoperation ($p > 0.05$).

CONCLUSIONS: RSA leads to predictable improvements in pain and function in patients with an os acromiale. Radiographic tilt of the os may be appreciated in one third of the shoulders, without noticeable effect on outcomes. Pain related to the os after RSA is rare.

Treatment of Dislocation After Reverse Shoulder Arthroplasty

Abstract ID: Paper 216

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BACKGROUND: Dislocation is an uncommon but challenging complication after reverse shoulder arthroplasty (RSA). There is a paucity of literature analyzing the treatment of dislocation after reverse arthroplasty. We sought to evaluate the nonoperative and operative treatment of all dislocations after primary and revision RSA.

METHODS: Between 2006 and 2013, dislocation occurred in 27 shoulders after RSA, including 12/1,081 primaries (1.1%) and 15/342 revisions (4.4%). Of these 27 patients, 12 (44%) were female, with an average age of 69 years. Seventeen (69%) shoulders dislocated within 3 months of surgery. Seventeen (69%) patients had partial or complete subscapularis deficiency and seven (26%) patients required glenoid bone grafting at the initial reverse arthroplasty. Ten (68%) patients in the revision RSA group had preoperative instability. The mean follow-up time after the index RSA was 4 years.

RESULTS: Closed reduction was attempted in 10 shoulders, and was successful in 60% (3 of 5 patients) of primary and 20% (1 of 5 patients) of revision RSA dislocations. Nineteen shoulders (70%) ultimately underwent operative treatment, including two patients who failed nonoperative treatment. Operative management of RSA dislocation was successful in 86% (6 of 7 patients) of primary and 64% (7 of 11 patients) of revision RSAs, respectively ($p = 0.40$). Overall, nine shoulders (33%) had a persistently dislocated RSA at final follow-up (2 of 12 (17%) primaries vs. 7 of 15 (47%) revisions, $p = 0.08$). Risk factors for chronic instability in the revision cohort included preoperative instability ($p = 0.02$) and surgical indication for revision of hemiarthroplasty ($p = 0.10$) or glenoid loosening ($p = 0.006$). Patients with a non-dislocated RSA at most recent follow-up had good functional outcomes, with mean shoulder elevation and external rotation of 110° and 34°, respectively. Worse functional outcomes were associated with dislocation of a revision RSA ($p=0.02$), preoperative instability ($p =0.006$), and female gender ($p=0.02$).

CONCLUSION: Two-thirds of the dislocations complicating RSA occur within the first three months after surgery, more commonly after revision RSA. Closed reduction is successful in over half of the dislocations after primary RSA and unsuccessful in most dislocated revision RSAs. Revision surgery is successful in approximately 85% of the dislocations after primary RSA and 65% after revision RSA. Female gender and a history of previous prosthetic instability are associated with worse outcomes. Every attempt should be made to achieve stability at the time of primary and revision RSA, since revision surgery is not guaranteed to restore stability.

Primary Reverse Shoulder Arthroplasty in Patients 80 Years of Age or Older

Abstract ID: Paper 217

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BACKGROUND: Reverse total shoulder arthroplasty (RTSA) improves shoulder pain and function for a variety of indications, but there is a lack of evidence on the safety of this procedure in the very elderly. This investigation assessed outcomes, complications, and mortality in a consecutive series of patients 80 and older undergoing primary RTSA.

METHODS: Between 2004 and 2014, 171 consecutive patients (179 shoulders) 80 years of age or older (mean age 83, range 80-92) underwent a primary RTSA. There were 112 women and 67 men. Indications included cuff tear arthropathy (n=136), osteoarthritis (n=23), proximal humeral nonunion or malunion (n=9), acute fracture (n=5), rheumatoid arthritis (n=3), chronic dislocation (n=2), and avascular necrosis (n=1). Patients were followed for a minimum of 2 years or until revision/death (mean follow-up 34.5, range 2 – 122 months).

RESULTS: RTSA resulted in significant improvements in pain ($p < 0.0001$), forward flexion ($p < 0.0001$), and active external rotation ($p < 0.0001$). The overall complication rate was 17%. There were 7 major (4.1%) and 3 minor (1.8%) medical complications. Surgical complications included dislocation (3, 1.8%), wound healing problems (2, 1.2%), and glenoid loosening (1, 0.6%). There was one revision for recurrent instability and one for glenoid loosening. The 2- and 5-year revision free survival rates were 99% and 98%, respectively. Overall results were excellent in 57 (34%), satisfactory in 97 (57%), and unsatisfactory in 15 (9%). At most recent follow-up, 31 (17%) patients had died at a mean time (range) of 41 (2-96) months from the time of the index arthroplasty.

CONCLUSIONS: RTSA is a relatively safe and effective surgical procedure in patients greater than 80 years of age. Age should not be used in isolation as an exclusion criterion in an otherwise acceptable surgical candidate.

MAOA BREAKOUT SESSION #15
SPORTS MEDICINE
April 22, 2017

Sensitivity and Specificity for a New Test for Anterior Cruciate Ligament

Abstract ID: Paper 218

View Session Detail

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INTRODUCTION: The current tests for anterior cruciate ligament (ACL) insufficiency include the Lachman, pivot shift, and anterior drawer tests. Recently, a new physical exam called the 'lever test', has been described to test for ACL insufficiency. The purpose of the current study is to determine the sensitivity, specificity, and accuracy of the lever test to detect ACL tear and compare the accuracy to the Lachman, anterior drawer test, and pivot shift test.

METHODS: Over a one-year period, 91 subjects with contact or non-contact knee injuries were analyzed (28 +/- 11 years of age; 61 males, 30 females). The Lachman test, anterior drawer, pivot shift, and the new lever test were performed in the office with the patient awake. Examiners were blinded as to the presence or absence of ACL injury. This new test was performed with the examiner's one hand pushing on the supine patient's thigh and the other hand placed in a fist under the patient's calve. When the ACL is intact, it is believed that the ACL linkage between the femur and tibia allowed the foot to lever up. Magnetic resonance imaging was used to determine the presence or absence of an ACL tear. Accuracy for the four tests was analyzed using chi-square and receiver operator curves (ROC) testing.

RESULTS: Seventy-six subjects (78%) had ACL tears. The sensitivity, specificity, and accuracy of the lever test was 83%, 80%, and 82%, respectively. The accuracy of the lever test was not statistically different than the Lachman, AD, and pivot shift ($p = 0.78$, 0.99, 0.07 respectively). There were 8 knees with concomitant ligament injuries: 5 grade 2 MCL, 1 grade 3 MCL, 1 grade 2 LCL, and 1 grade 2 MCL with grade 2 LCL tear. Neither the presence of another ligament tear nor the timing of the injury (acute vs. chronic) affected the accuracy of the lever test ($p=0.62$ and $p=0.47$ respectively). Forty-eight subjects had a meniscus tear on MRI (13 medial, 12 lateral, 23 both medial and lateral). The presence of a meniscus tear decreased the accuracy of the lever test ($p=0.003$).

DISCUSSION AND CONCLUSION: The lever test showed high sensitivity, specificity, and overall accuracy in detection of ACL tear. The accuracy of the lever test was not significantly different from the Lachman, anterior drawer, or pivot shift tests.

Femoral Cortical Button Malpositioning Rates in Anterior Cruciate Ligament Reconstruction

Abstract ID: Paper 219

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INTRODUCTION: Cortical buttons are frequently used for femoral fixation during anterior cruciate ligament (ACL) reconstruction. The rate of malposition of the cortical button has not been studied. The purpose of this retrospective case review is to determine the incidence of cortical button malposition on postoperative radiographs. The primary hypothesis of this study is that cortical button malposition will be an infrequent occurrence with a prevalence of less than 5%.

METHODS: After IRB approval, a retrospective review of all ACL reconstructions performed from September 2009 through May 2014 at a single center was completed. Only patients with cortical button femoral fixation and postoperative AP and lateral radiographs were included. Postoperative button position was graded as follows: reduced/congruent (entirety of button is <2 mm from cortex); reduced/incongruent (part of button is <2 mm from cortex, part of button is >2 mm from cortex); displaced (all of button is >2 mm from cortex); intraosseous (all or part of button remains within bone); and ungradable. Radiographs were evaluated by two individuals at two time points to define inter- and intra-rater reliability. The reliability calculations were performed by a statistician.

RESULTS: 2,182 patient's charts who underwent ACL reconstruction were reviewed. A total of 563 patients had graft fixation using a femoral cortical button. 362 of these patients had postoperative radiographs available for review. 307 (84.8%) buttons were reduced/congruent. 19 (5.2%) buttons were reduced/incongruent. 9 (2.5%) buttons were displaced. 12 (3.3%) buttons remained intraosseous. 14 (4.2%) buttons were ungradable based upon the postoperative imaging. The inter-rater reliability as measured by the kappa coefficient was greater than 0.7, indicating substantial agreement.

DISCUSSION/CONCLUSIONS: Cortical button placement during femoral fixation in ACL reconstruction is widely variable. This study introduces a novel and reproducible classification system that allows the objective grading of cortical button positioning. In doing so, we were able to define the rate of cortical button malpositioning, which was higher than anticipated (15%).

Pain Assessment After Anterior Cruciate Ligament Reconstruction: Bone-Patellar Tendon-Bone vs. Hamstring Tendon Autograft

Abstract ID: Paper 220

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BACKGROUND: Anterior cruciate ligament (ACL) reconstruction is a common outpatient procedure that is accompanied by significant postoperative pain.

PURPOSE: To determine differences in acute pain levels between patients undergoing ACL reconstruction with bone-patellar tendon-bone (BTB) vs. hamstring tendon (HS) autograft.

STUDY DESIGN: Prospective cohort, level 2.

METHODS: A total of 70 patients who underwent primary ACL reconstruction using either BTB or HS autografts were consented for participation. The primary outcome of the study was postoperative pain levels (visual analog scale), which were collected for 4 days postoperatively. Secondary outcomes assessed included opioid consumption (intravenous morphine equivalents), hours slept, patient satisfaction, and calls to the physician.

RESULTS: Patients treated with BTB autografts had increased pain when compared to those treated with HS autografts in the first 3 days postoperatively, mean ± standard deviation 6.0 ± 1.7 vs. 5.2 ± 2.0 (day 0), 5.9 ± 1.7 vs. 4.9 ±1.7 (day 1), 5.2 ± 1.9 vs. 4.1 ± 2.0 (day 2), ($P = .066$, $P = .024$ and $P = .032$, respectively). There were also significant increases in reported breakthrough pain (76% vs. 43% day 0, 64% vs. 35% day 1) and calls to the physician due to pain (19% vs. 0% day 1) in the BTB group ($P = .009$, $P = .033$, and $P = .041$, respectively). There were no significant differences in narcotic requirements or sleep disturbances. Overall, the BTB group reported significantly less satisfaction with pain management on days 0 and 1, $P = .024$ and $P = .027$.

CONCLUSION: A significant increase in acute postoperative pain was found when performing ACL reconstruction with BTB autograft compared to HS. Patients treated with BTB autograft were also more likely to have breakthrough pain, decreased satisfaction with their pain management, and to contact their physician due to pain. These findings suggest a difference in early postoperative pain between the 2 most common graft options for ACL reconstruction. Patients should be informed of the differences in acute postoperative pain in addition to other factors when deciding on graft choice with their physician.

Do Skin Tears with Arthroscopic Knot Tying Represent a Contamination Risk?

Abstract ID: Paper 221

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INTRODUCTION: It is estimated that the rate of glove perforation in clinical arthroscopic procedures is between 26-57%, but the risk of cross-contamination due to these tears is unknown. This study's purpose was to quantify the number of epithelial cells found on arthroscopic suture following arthroscopic knot tying and to see if this correlates with the presence of glove tears and/or number of knots thrown between glove changes.

MATERIALS AND METHODS: Using a standardized technique, knots were tied arthroscopically by two orthopedic surgeons using #2 UltraBraid suture. Gloves (both inner and outer) were changed and collected after tying knots for two sutures, four sutures, or six sutures. Both sets of gloves were tested for perforation (1) using an electroconductivity meter in a saline bath, and (2) using a saline load test. Sutures were collected after each suture was tied and placed into sterile ThinPrep CytoLyt solution vials for cytopathologist analysis, where the number of epithelial cells in 10 high-powered fields (hpf) was counted. Positive and negative suture control samples were created. Descriptive statistics were calculated.

RESULTS: All inner (12) and outer (12) gloves were analyzed for perforations. Only one glove tear was present after tying one 6-suture set – giving a perforation rate of (1) 4.2% overall and (2) 8.3% for outer gloves. The number of epithelial cells found in 10 hpf for the: (1) positive control was 244 cells (SD 18, Range 231-257), (2) negative control #1 (i.e., empty containers) was 1 cell (SD 0, Range 1-1), and (3) negative control #2 (i.e., untouched sutures) was 10 cells (SD 5, Range 5-15). Test sample epithelial cells in 10 hpf by the number knots tied were: (1) 2 cells (SD 2, Range 0-5), (2) 1 cell (SD 0, Range 1-1), (3) 1 cell (SD 1, Range 0-3), (4) 1 cell (SD 0, Range 1-1), (5) 4 cells (SD 4, Range 1-7), and (6) 1 (SD 0, Range 1-1), respectively.

CONCLUSIONS: No prior studies have quantified the number of epithelial cells found on suture after arthroscopic knot tying. Although epithelial cells were identified on suture in every sample, the number did not differ from those found in the negative controls and there were no simultaneous inner/outer glove perforations. This implies that the laceration represents an indirect friction injury or pressure necrosis, rather than actual contact between the suture material and the surgeons' skin.

Comparative Outcomes of All-Inside and Inside-Out Repairs of Bucket-Handle Meniscal Tears

Abstract ID: Paper 222

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BACKGROUND: Bucket-handle meniscus tears are common, with all-inside and inside-out techniques available for repair. However, there is currently a lack of evidence comparing these meniscus repair techniques. The goals of this study were to compare clinical outcomes following surgical repair of bucket-handle meniscus tears utilizing either an all-inside or inside-out technique, identify potential risk factors for failure, and develop a treatment algorithm.

METHODS: The records of all patients who underwent bucket-handle meniscal repair between 2003 and 2013 were retrospectively reviewed. Bucket-handle tears were defined as predominantly vertical longitudinal tears in the posterior horn and body segments that displaced into the affected compartment. Seventy patients (48 male, 22 female) were included in the study, with an average age of 23.5 years (range, 12.7 – 47.0 years). 42 menisci were repaired with an inside-out technique using zone specific cannulas and 2-0 Ethibond suture. In comparison, 28 were repaired utilizing all-inside suturing devices. The primary end point was survival free of clinical retear. Clinical outcomes included pre- and postoperative IKDC and Tegner scores, as well as physical examination. Minimum follow-up was 2 years or repair failure.

RESULTS: At a mean follow-up of 4.4 years (range, 0.6 – 8.5 years), there were 5 failures (18%) in the all-inside group, and 11 failures (26%) in the inside-out group ($p = 0.4$). Average time to failure was a mean of 16 months postoperatively (range, 4-58 months). There were no significant differences observed between groups in terms of Tegner activity scales, IKDC scores, or range of motion. No significant differences were observed between repair type when subcategorizing by age, gender, BMI, tear complexity, tear chronicity, rim width, or medial versus lateral-sided repair. There was a significant selection bias with larger ($p<0.001$), medial sided ($p=0.003$), and avascular ($p=0.01$) tears being more common in the inside-out group. There were more minor complications in the inside-out group ($p=0.02$). Smoking was an independent risk factor for failure and lower IKDC score irrespective of repair type ($p=0.03$).

CONCLUSION: Overall, satisfactory clinical outcomes are achievable at short to mid-term follow-up with both inside-out and all-inside repair of bucket handle meniscal tears in appropriately selected patients. In this study, inside-out meniscal repair was more commonly utilized for large and/or complex tears, especially those involving the avascular zone or the medial meniscus.

Performance of PROMIS in Healthy Patients Undergoing Meniscal Surgery

Abstract ID: Paper 223

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INTRODUCTION: Surgeons rely on patient reported outcome instruments (PROs) to assess a patient's current health status and guide treatment. Many PROs have been developed including the National Institute of Health's Patient Reported Outcome Measurement Information System (PROMIS). PROMIS utilizes computerized adaptive testing (CAT) to focus questioning and decrease test burden. PROMIS has been shown to be reliable in functionally impaired patients, but previous works have speculated that ceiling effects may decrease sensitivity in healthy populations. In the current study, patients undergoing surgery for meniscus injuries completed the PROMIS physical function CAT (PROMIS PF CAT) with the hypotheses that: (1) PROMIS PF CAT will have at least a moderate correlation with commonly used knee PROs; (2) ceiling effects will not be present; and (3) test burden will be low.

METHODS: Patients scheduled for meniscus repair, meniscectomy, or debridement as the primary procedure were enrolled in this Institutional Review Board approved study. Patients undergoing significant simultaneous surgeries and patients with grade 4 osteoarthritis/chondromalacia were excluded. The PROMIS PF CAT, Knee Injury & Osteoarthritis Outcome Score (KOOS), Marx Knee Activity Rating Scale (Marx), and Short Form-36 (SF-36) were completed. Correlations were assessed using the appropriate Pearson or Spearman rank correlation (significance $p<0.05$). Correlations were designated: high (≥0.7); high-moderate (0.61-0.69); moderate (0.4-0.6); moderate-weak (0.31-0.39); and weak (≤0.3). A significant floor or ceiling effect was defined as >15% of respondents scoring the lowest or highest possible score.

RESULTS: After exclusion criteria, 32 subjects were identified (mean age=37.8, 66% male). PROMIS PF CAT had high-moderate correlations with KOOS ADL ($r=0.67$, $p<0.01$) & KOOS Sport ($r=0.64$, $p<0.01$), and moderate correlations with KOOS Symptoms ($r=0.45$, $p<0.01$), KOOS Pain ($r=0.59$, $p<0.01$), KOOS QOL ($r=0.57$, $p<0.01$), SF-36 PF ($r=0.44$, $p=0.01$), and SF-36 Pain ($r=0.45$, $p<0.01$). Mean number of items for completion of PROMIS PF CAT was 4.1 (range 4-6). PROMIS PF CAT had no floor (0%) or ceiling (0%) effects; Marx was the only PRO with floor (25%) and/or ceiling (25%) effects.

DISCUSSION: In patients undergoing surgery for meniscal tears, the PROMIS PF CAT has a high-moderate or moderate correlation with currently used PROs and no significant floor or ceiling effect. We recommend the use of the PROMIS PF CAT in similar meniscal tear populations due to its comparability with current tests and its lower test burden. Assessing its

validity in other populations and investigating the potential utility of more specific domains is warranted.

Biomechanical Evaluation of Suture Anchor vs. Transosseous Tunnel Patella Tendon Repair Techniques

Abstract ID: Paper 224

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OBJECTIVES: The current gold standard for management of an acute patella tendon rupture is surgical repair through transosseous patellar bone tunnels. Few studies have been published comparing the biomechanical properties of suture anchor versus transosseous patella tendon repair.

METHODS: Twelve cadaveric ‘patella-only’ specimens were used. DXA measurement was performed to ensure equal bone quality amongst groups. Specimens were randomly assigned to either a suture anchor repair of patella tendon group (n=6) or a transosseous tunnel repair group (n=6). Suture type and repair configuration were equivalent. After the respective procedures were performed, each patella was mounted into a gripping jig. Tensile load was applied at a rate of 0.1 mm/s up to 100N after which cyclic loading was applied at a rate of 1 Hz between magnitudes of 50-150N, 50-200N, 50-250N, and tensile load at a rate of 0.1mm/s until failure. Failure was defined as a sharp deviation in the linear load vs. displacement curve. Failure mode was recorded. Results were compared statistically.

RESULTS: DXA demonstrated no significant differences in bone quality between the two groups (p=.075). The ultimate load to failure of the transosseous tunnel and suture anchor groups was 287.02N +/-100.82 and 258.46N +/-63.04, respectively, with no significant differences found between groups (p=0.43). All specimens within the suture anchor cohort failed by pulling out suture anchors except for one which failed through tendon midsubstance. All specimens within the transosseous cohort failed through the midsubstance of the tendon except for one which failed through suture breakage.

CONCLUSION: In this cadaveric model, suture anchor repair demonstrated similar biomechanical profile regarding cyclic loading and ultimate load to failure when compared to ‘gold standard’ transosseous tunnel patella tendon repair. While in vivo study is required, suture anchor patella tendon repair may be a viable alternative to transosseous repair. Benefits include decreased surgical dissection and reduced risk of patella fracture, although cost effectiveness is a concern. Both repair strategies have decreased force to failure versus native patella tendon, suggesting that a protective early rehabilitation strategy may be advisable.

Osteochondral Allograft Donor-Host Matching by Femoral Condyle Radius of Curvature

Abstract ID: Paper 225

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BACKGROUND: Conventional osteochondral allograft (OCA) matching, requiring orthotopic, size-matched condyles, and narrow surgical time windows often prohibit timely transplantation.

HYPOTHESIS: We hypothesize that femoral condyle radius of curvature (RoC) is an appropriate isolated matching criterion for donor-host matching in fresh osteochondral allograft, potentially enhancing matching efficiency when compared to conventional matching techniques.

STUDY DESIGN: Descriptive Laboratory Study

METHODS: (I) Three-dimensional digital reconstructions of 14 randomly-selected cadaveric distal femoral hemicondyles were created. Each condyle was divided into anterior, middle, and posterior zones. A virtual best-fit grid was applied to each, and each zone's sagittal and coronal plane RoC were determined. Seven non-orthotopic OCA transplants were performed based upon RoC matching with one millimeter tolerance, and the pre- and post-surgical surface geometry was quantified to assess the accuracy of articular surface restoration. Of note, each donor-host pair did not match by conventional methods. (II) Twelve cadaveric distal femora were categorized by size and digitized in the aforementioned manner. Simulated circular defects measuring 20, 25, and 30 mm in diameter were introduced into each zone. OCA graft matches were determined based upon donor and host RoC, and the total number of potential matches out of 71 total comparisons were recorded as a percentage for each simulated defect. Finally, the results of RoC matching were compared to conventional methods for simulated defects in the middle zone of each medial femoral condyle.

RESULTS: (I) The average surface deviation after OCA transplantation was -0.09 millimeters with a mean maximal protrusion at any point of 0.59 millimeters. (II) Using RoC, 20 mm defects had a 100% chance of being matched. Defects of 25 and 30 mm had a 91% and 64% chance of being matched, respectively. Compared to conventional method, the RoC method yielded a 3.2-fold greater match rate for lesions of the medial and lateral femoral condyles ($p = 0.02$).

CONCLUSION: This investigation shows that femoral condyle sagittal and coronal RoC may be useful alternative matching criteria, expanding upon current standards.

Platelet Rich Plasma Composition: A Study Comparing Centrifugation and Centrifugation Plus Flow Cytometry

Abstract ID: Paper 226

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INTRODUCTION: Platelet rich plasma (PRP) is being used increasingly to treat a variety of orthopedic conditions. Reported outcomes after PRP treatment have been mixed depending on the condition being treated, timing of treatment, and composition of the PRP product used. Because composition has shown clear effects on outcomes, and there is a lack of standardization of PRP formulations, the present study was designed to investigate the composition of PRP produced using two different commercially-available methods for making leukoreduced (LR) PRP, centrifugation plus flow cytometry (Cent+Flow) (Angel system) and centrifugation alone (Cent) (ACP system). We hypothesized that the centrifuge plus flow cytometry method would produce a more consistent LR-PRP as compared to the centrifuge alone method.

METHODS: With IRB approval, 22 healthy volunteers were enrolled with 20 completing the study. Venous blood (70 ml) was obtained and distributed for processing as follows:
• Whole blood (n=20) – 3 ml in EDTA tube for complete blood count (CBC)
• Cent (+ACDA) (n=10) – 13.5 ml into Cent syringe containing 1.5 ml ACDA for processing in centrifuge at 1500xg for 5 minutes
• Cent (-ACDA) (n=10) – 15 ml into Cent syringe for processing in centrifuge at 1500xg for 5 minutes
• Cent+Flow (n=20) – 52 ml into 60 ml syringe containing 8 ml ACDA for processing in Cent+Flow system using 60 ml x 2% setting

Each PRP product was processed according to manufacturer's instructions and submitted for CBC analysis in our hospital laboratory. Data were pooled by group and analyzed using one-way ANOVA. Coefficient of variation (x100) was calculated for Cent (+ACDA) combined (n=20) and Cent+Flow PRP (n=20) for each outcome measure.

RESULTS: No statistically significant ($p>0.2$) differences were noted between Cent (+ACDA) and Cent (-ACDA) for any outcome measure. Cent volume was significantly ($p<0.001$) higher than Cent+Flow PRP volume. Cent+Flow PRP platelet concentration vs. whole blood was significantly ($p<0.001$) higher than PRP platelet concentration vs. whole blood for both ACP groups. Leukoreduction was not significantly ($p=0.13$) different among groups. Standard deviations and coefficients of variation were similar between products for each parameter measured, and were acceptably low for clinical application of these orthobiologics.

CONCLUSION: Both systems consistently produced LR-PRP for each subject, suggesting that choice of product can be determined based on physician preferences and intended application.

Incidence of Surgical Repair for Core Muscle Injury and Impact on Performance in Elite American Football Players

Abstract ID: Paper 227

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PURPOSE: Core muscle injury, also known as “athletic pubalgia “or “sports hernia” is a significant source of disability in American football athletes and surgical management typically yields excellent outcomes. However, continued participation increases the risk for recurrent injury. This study examines the incidence and impact of core muscle injury repair and recurrent tearing in elite American football athletes on prospective, short-term performance in the National Football League (NFL).

METHODS: Results from 1,311 athletes invited in the Combine from 2012 to 2015 were evaluated. Athletes with a history of core muscle injury repair and recurrent tearing on magnetic resonance imaging (MRI) were identified using the NFL Combine Database. NFL performance outcomes based on draft status, games played, games started and current status in the NFL following the 2015 regular season were gathered using publicly available databases (minimum: one year; maximum: four years). Statistical analysis was performed to detect for significant associations between athlete history and NFL performance in the presence of core muscle repair and recurrent tearing. Multivariable logistic regression was used to determine significant predictors of NFL performance in athletes with recurrent tearing.

RESULTS: Core muscle injury repair was identified in 4.2% (n=55) of athletes. MRI was performed at the Combine in 35% (n=19 of 55) of athletes with repair, of which 53% (n=10 of 19) had evidence of recurrent tearing. Compared to athletes with no history of core muscle injury repair, athletes with repair were not at risk of playing (P=.87) or starting (P=.45) fewer NFL regular season games, going undrafted (P=.27), or not being on an active NFL roster (P=.51). Compared to athletes with intact repairs, recurrent tearing did not have a significant impact on NFL games played (P=.74), games started (P=.48), draft status (P=.26), or being on an active roster (P=.74). Offensive linemen had a significantly higher risk of recurrent tearing (P=.005) along with athletes with a history of repair within one year of the Combine (P=.03).

CONCLUSION: Athletes with a history of core muscle injury repair or recurrent tearing are not at increased risk for diminished, short-term performance in the NFL. As such, athlete history and MRI following core muscle injury repair in athletes at the NFL Combine does not provide significant predictive information regarding future performance. However, offensive linemen and athletes less than one year out from surgery demonstrate higher risk for recurrent tearing.

Major League Pitching Workload After Primary Ulnar Collateral Ligament Reconstruction and Risk for Revision Surgery

Abstract ID: Paper 228

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INTRODUCTION: Previous literature has attempted to correlate pitching workload with risk of ulnar collateral ligament (UCL) injury. However, no study has specifically attempted to evaluate workload after UCL reconstruction and its relationship with future injury and need for revision reconstruction in Major League Baseball (MLB) pitchers.

PURPOSE/HYPOTHESIS: The purpose of this study was to compare the workload of pitchers who have underwent a primary UCL reconstruction and required a revision UCL reconstruction to those that did not require a revision UCL reconstruction.

STUDY DESIGN: Retrospective, case-controlled study. Level of evidence, 3.

METHODS: A total of 29 MLB pitchers who underwent primary UCL reconstruction surgery and subsequently required revision reconstruction were identified and compared with 121 MLB pitchers that underwent primary reconstruction but did not later require revision surgery. Games pitched, pitch counts, and innings pitched were evaluated and compared for the first season after returning from primary reconstruction and for the last season pitched before undergoing revision surgery.

RESULTS: Workload between pitchers that required revision reconstruction compared to those that did not had no statistically significant differences in regards to games pitched, innings pitched, and MLB only pitch counts. The one significant difference in workload was in total pitch counts (combined MLB and minor league), with the pitchers who required revision surgery pitching less than those that did not (primary: 1413.6 pitches vs. revision: 959.0 pitches, $p=0.04$). Additionally, pitchers that required revision surgery underwent primary reconstruction at an early age (22.9 years vs. 27.3 years, $p<0.001$) and had less MLB experience (1.5 years vs. 5.0 years, $p<0.001$).

CONCLUSIONS: This current study found that there was no specific pitch count, innings count, or number of games pitched that places a pitcher at an increased risk for injury requiring revision UCL reconstruction. However, correlations of risk with injury and revision UCL reconstruction may be younger age and less MLB experience at time of primary reconstruction.

Proximal Radial Epiphyseal Injuries in Gymnasts: A Case Series

Abstract ID: Paper 229

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PURPOSE: To describe the clinical and imaging characteristics in a series of gymnasts with proximal radial epiphyseal stress injuries.

METHODS: Gymnasts < 18 years old treated for elbow injuries to the proximal radius in a pediatric sports medicine practice over a 24-month period were identified. Demographics, associated pathology, radiographic imaging data, and treatment were documented. Proximal radial non-acute injuries isolated or in conjunction with other elbow pathology were included. Acute fractures from a defined traumatic event, an anatomic elbow abnormality, congenital or remote traumatic radial head subluxation, or prior malunion were excluded.

RESULTS: Six high level gymnasts, average level of 9, were identified. Four of 6 (67%) patients had a Salter-Harris III fracture type, while the remaining two had Salter-Harris IV fractures. The mean age was 11.7 years (9-14) and mean BMI was 15.4 (12.1-16.7). All patients were skeletally immature upon presentation with a mean Sauvegrain bone age of 10.8 years (9.7-11.8). Five of 6 patients received prior medical evaluation and experienced a sudden increase over chronic pain. Four of 6 (67%) patients recalled experiencing a pop. The mean time from symptom spike to clinic presentation was 40 days (9-123). Three (50%) patients had associated medial epicondylitis or UCL strains, one (17%) had associated capitellar OCD, and one (17%) had associated distal radial epiphysiolysis. Two (33%) had a contralateral elbow condition.

All six patients had signs of valgus overload, with associated with medial-complex pain or valgus limb alignment. Three (50%) patients had a central cartilage defect and one (17%) had physeal displacement. Imaging revealed radial metaphyseal edema in three (50%) patients, contralateral metaphyseal irregularity in three (50%) patients, and a contralateral epiphyseal cleft in one (17%) patient. An open reduction internal fixation surgical procedure was performed on three (50%) patients. Average time to union was 92 days (65-136). All patients remain in gymnastics.

CONCLUSIONS: Proximal radial epiphyseal injuries may be associated with medial complex overload or valgus alignment in the upper extremity weight bearing athlete. Results from future studies may aid in development of injury surveillance and prevention methods for this less commonly recognized cause of lateral elbow pain in gymnasts.

Seasonal Timing of Ulnar Collateral Ligament Injury in Major League Pitchers

Abstract ID: Paper 230

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(Presented by Chase B. Ansok, M.D., Detroit, MI)

BACKGROUND: The number of Major League Baseball (MLB) pitchers requiring ulnar collateral ligament (UCL) reconstructions is increasing. Recent literature suggests that UCL injuries are due to the chronic repetitive stresses of throwing a baseball. With a 162 game season, some have suggested that pitchers are subject to too much stress on their throwing arm. Our purpose was to evaluate when in the season MLB pitchers injure their throwing elbow.

METHODS: A total of 182 MLB pitchers who had undergone UCL reconstruction while playing in the major leagues between the years of 1994-2014 were identified. The last pitching performance date before UCL reconstruction was used as a relative time for UCL injury date. Pitchers were evaluated to determine the number of innings pitched and pitches the last game before surgery as well as one week and one month prior to the last game pitched. Data was evaluated to determine at what point in the season pitchers injured their elbow.

RESULTS: The majority of pitchers pitched their last game prior to injury at the end of the season in September or October (57 and 11 pitchers, respectively), with the second highest number of pitchers in May (28 pitchers). There were 53 pitchers injured during games 1-54 of the season, 37 pitchers during games 55-108, and 92 played their last game during games 109-162. The week prior to injury, pitchers averaged 1.27 games (starters: 0.79; relievers: 1.73), 2.81 innings (starters: 4.22; relievers: 1.43) and 49.01 pitches (starters: 70.35; relievers: 27.75). The month prior, pitchers averaged 5.24 games (starters: 3.90; relievers: 6.54), 13.46 innings (starters: 21.40; relievers: 5.7) and 167.23 pitches (starters: 353.11; relievers: 115.34).

CONCLUSION: The specific time period that MLB pitchers injure their throwing elbow appears to have a bimodal distribution, with an increase at the beginning of the baseball season and another towards the end. The largest temporal group of pitchers requiring UCL reconstruction pitched their last game at the end of the regular season. This suggests that a majority of UCL injuries occurred towards the end of the season supporting the perception that UCL injury may be related to overuse throughout a 162 game baseball season. However, the finding of increased injury at the beginning of the season is novel and counterintuitive to the current understanding. More evaluation is needed in the early season injury cohort to assess for modifiable factors not related to the overuse of a full season.

Return to Play After Shoulder Instability in National Football League Athletes

Abstract ID: Paper 231

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INTRODUCTION: Shoulder instability is common in the National Football League (NFL) and has a wide spectrum of outcomes. The return to play (RTP) percentage and the factors affecting RTP after these injuries are not well defined.

METHODS: A total of 45 NFL players who sustained a shoulder instability event were evaluated. Return to NFL play, incidence of surgery, time to return, recurrent instability events, seasons and games played after injury, and demographic data were collected. Overall, RTP was determined and players who had surgery were compared to those who did not have surgery. Factors assessed after RTP were compared with age, position, size and experience matched control players.

RESULTS: Ninety-one percent (41 of 45) of NFL players returned to NFL regular season play at an average of 1.6 ± 1.9 weeks (mean ± SD) in those sustaining a shoulder subluxation (N = 7) and 3.7 ± 5.4 weeks in those sustaining a dislocation (N = 34); p = .53. NFL players drafted after the 2nd round were less likely to return to play than those drafted earlier (40% versus 100%); p = .04. In players who were able to RTP without surgery, those having a left shoulder instability event were able to return faster (1 week) than those having a right shoulder event (4 weeks); p = .03. Twenty-eight players underwent surgical stabilization and 24 players (86%) returned to play the following season. Players who had surgery were more likely to have a second instability event in their career (58% versus 9%); p = .01. In the season following an instability event, NFL players played in 1.9 ± 3.6 games less per season than prior to the injury (p = .02). No difference was found when comparing players who returned to the same team versus those who did not, as well as players that RTP versus matched controls.

DISCUSSION AND CONCLUSION: There is a high rate of RTP following shoulder instability events in NFL players. Players injuring their non-dominant arm return to play at a faster rate and those drafted in earlier rounds were more likely to return. Surgical stabilization of the shoulder following injury may not completely eliminate potential for subsequent recurrent events as a high percentage of surgically treated players will have another instability event. After returning from instability events, NFL players were likely to play fewer games per season.

Incidence and Impact of Scaphoid Fracture Repair in Elite American Football Athletes

Abstract ID: Paper 232

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PURPOSE: Surgical fixation for scaphoid fractures is often recommended in elite athletes to hasten healing and return to sport. Complications, such as nonunion, negatively impact athletic performance. The purpose of this study is to examine the incidence and outcomes following scaphoid fracture repair in athletes invited to the National Football League (NFL) Scouting Combine.

METHODS: A total of 1,311 football athletes invited to the NFL Combine from 2012 to 2015 were evaluated for history of scaphoid fracture with surgical repair. Athlete demographics, surgical history, imaging reports, and physical exam findings were recorded using the NFL Combine Database. Future performance based on draft status, NFL games played, games started, and current status following the 2015 regular season were gathered using publicly available databases. Statistical analyses were performed to measure the impact of scaphoid repair on NFL performance and to define significant predictors of future performance in athletes with repair.

RESULTS: Scaphoid repair was identified in 19 athletes (1.4%). The highest incidence of repair was in linebackers (n=4, 21%). Functional deficits were present in 47% (n=9) of athletes. Compared to athletes invited to the Combine without scaphoid repair, athletes with repair were not found to play or start fewer regular season games or possess lower odds of being drafted or on an active NFL roster. Defensive backs had a higher prevalence of arthritic changes relative to other positions. Within the cohort of athletes with repair, those with radiographic evidence of arthritis were more likely to be free agents while linebackers had significantly lower odds of playing ≥10 games.

CONCLUSIONS: Defensive backs had a higher incidence of degenerative changes following scaphoid repair relative to other positions. Prospective performance may be compromised in athletes with arthritic changes or those playing the linebacker position.

Utility of Magnetic Resonance Imaging in Predicting Outcomes Following Shoulder Labral Repair

Abstract ID: Paper 233

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BACKGROUND: Shoulder instability is common in American football and can lead to a decrease in player performance. The purpose of this study is to investigate the utility of history, physical exam, and magnetic resonance imaging to assess risk factors for recurrent labral tearing and future performance in the National Football League.

METHODS: A total of 1,311 football players at the National Football League Scouting Combine between 2012 and 2015 were retrospectively reviewed. Medical records were reviewed for athletes with a history of shoulder labral repair. Prospective data was gathered using publicly available databases. Statistical analysis was performed to determine significance between the athletes' history, recurrent labral tearing, or functional deficits on exam on future performance.

RESULTS: Labral repair was identified in 148 (11.3%) of athletes. Recurrent labral tearing (n=47 athletes, 28.5%) was associated with bilateral repairs (p=0.048), revision surgery (p=0.001), or being >1-year postoperative from the Combine (p=0.002). Athletes with functional deficits were more likely to have had concomitant surgery during repair (p=0.01), glenohumeral arthritis on magnetic resonance imaging (p=0.02) or play offensive line (p=0.0001), linebacker (p=0.04) or wide receiver (p=0.0001). Prospectively, recurrent labral tearing was not associated with an athlete's chances of being drafted or playing a regular season game ($p<0.05$). Athletes with functional deficits were less likely to start a regular season game if they underwent surgery within 1 year of the Combine (p=.022) or had a reverse Hill-Sachs lesion (p=.035). Defensive backs with functional deficits were less likely to be on a current NFL roster (p=.035). Wide receivers were at lower odds of being drafted (p=.026). Athletes with radiographic evidence of arthritis (p=.039) or a reverse Hill-Sachs lesion (p=.017) were less likely to be on a current roster following the 2015 regular season.

CONCLUSION: The presence of functional deficits, bony or degenerative changes on imaging, and player position provides clinically useful information regarding future performance in the National Football League.

Incidence and Impact of the Latarjet Procedure in American Football Athletes Participating in the National Football League Scouting Combine

Abstract ID: Paper 234

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PURPOSE: The Latarjet procedure is utilized in athletes with recurrent shoulder instability and bone loss. The purpose of this study was to evaluate the incidence of Latarjet surgery and impact of postoperative functional deficits and concomitant shoulder pathology on future short-term performance in athletes invited to the National Football League (NFL) Scouting Combine.

METHODS: A total of 1,311 American football athletes invited to the NFL Combine from 2012 to 2015 were evaluated for history of Latarjet surgery. Athlete demographics, surgical history, imaging, and physical examination results were recorded using the NFL Combine Database. Prospective performance outcomes in the NFL in regards to draft status, games played, games started, and current NFL status (minimum: 1 year, maximum: 4 years) were gathered using available databases. Prospective data was analyzed by comparing athletes with a history of Latarjet surgery to all athletes invited to the Combine from 2012 to 2015. Continuous variables were compared using the student t-test and categorical variables were compared using the chi-squared test. For variables with an expected frequency of five or less, a Fischer's exact test was performed. A p-value of <0.05 was used to determine statistical significance.

RESULTS: Latarjet surgery was performed in 10 shoulders in 10 athletes (0.76%) with the highest incidence in defensive backs (n=3, 30%). Functional deficits in shoulder motion were exhibited in 70% (n=7) of athletes, while 40% (n=4) had evidence of glenohumeral arthritis and 40% concurrent injuries (n=2 labral tears, n=2 Hill-Sachs lesions). Screw breakage was noted on imaging in 20% (n=2) of athletes. Statistical analysis demonstrated that athletes with Latarjet repair trending towards being free agents (P=.05) when compared to all Combine participants; however, there was no reduction in games played (P=.27), started (P=.26) or total NFL season played (P=.21).

CONCLUSION: Despite trending towards being at higher risk to be free agents, future short-term performance in the NFL is not significantly diminished in athletes with a history of Latarjet repair when compared to athletes without repair.

Validation of Digital VAS Pain Scoring with Traditional Paper Based VAS Pain Scale in Adults

Abstract ID: Paper 235

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INTRODUCTION: The paper based Analog Scale (VAS) for pain assessment is commonly used to determine a patient's level of pain by having them make a mark on a straight line (0-100 mm | no pain – worst pain).

PURPOSE: To compare paper based VAS assessment to laptop and mobile phone based VAS platforms.

METHODS: IRB approval was obtained for this prospective randomized controlled trial. One-hundred orthopedic patients (Age 18+) were recruited and following consent, patients were asked to record ratings of perceived pain (Scale: 0–100 | no pain - worst pain) via a traditional paper based VAS scale and digitally via either laptop or mobile phone based online platforms (order of recording randomized between subjects). To determine if an interaction was present between the VAS platforms, a Mixed-Model ANCOVA (co-varying on paper VAS ratings as the current standard of measurement) was used followed by a Bonferroni post hoc test (α=0.05). A Bland Altman analysis was used to test for instrument agreement between the 3 measurement platforms. Following statistical analysis, 2 outliers were excluded due to possible measurement error leaving a total of 98 subjects (♂n=51, 44±16yr, ♀n=46±15yr).

RESULTS: No interaction was found between gender or age and both were excluded from the final statistical model. Our final analysis revealed a difference between the mobile phone (33.00±0.38) and both the laptop (31.02±0.38) and paper-based (31.05±0.38) platforms ($p<0.01$). No differences were observed between the paper and laptop platforms. Measurement agreement was found between the paper and laptop (mean diff. = -0.04±09, no proportional bias detected), but not paper- and mobile phone-based platforms (mean difference = -1.93±0.46, proportional bias detected).

CONCLUSIONS: Although differences observed between the phone and paper platforms may be considered clinically negligible (~-2), our mobile phone-based VAS platform remains un-validated. It is unclear as to whether visual scale or test administration contributed to the detected differences. In contrast, laptop computer based VAS assessment of pain yields results that are in agreement with traditional based paper-based assessment and may provide diagnostic value and expediency for the monitoring and logging of pain in the modern clinical or home setting.

Influence of E-mail in Acquisition of Patient Reported Outcome Measures (PROMs)

Abstract ID: Paper 236

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INTRODUCTION: Patient Reported Outcome Measures (PROMs) have become increasingly important in assessing clinical outcomes. However, acquisition of data at routine time intervals can be challenging. The influence of e-mail reminders in procuring data that would have otherwise been lost is unknown.

METHODS: A retrospective database review utilizing a custom query of our institution's Shoulder and Elbow Repository was performed by CareSense between 10/02/2012 and 07/02/2013. A total of 186 shoulder surgical patients with completed preoperative office-based tablet surveys (Simple Shoulder Test [SST] and Short Form-12 [SF-12] PROMs) were reviewed for completeness of PROMs at routine follow-up of 1 and 2 years. When office visits were missed, e-mail reminders with links to online surveys were generated without further incentives. Improvement in data acquisition achieved using e-mail reminders and online survey completion was assessed. The influence of the procedure performed was further analyzed to determine if patients treated with different surgical procedures would be more compliant with PROM completion.

RESULTS: Use of e-mail reminders significantly increased the number of patients for whom complete follow-up data was obtained. Compared to tablet surveys completed during office visits alone, the addition of e-mail reminders increased the collection of complete PROM data (both 1 and 2 year follow-up) by 25.8% ($p<0.001$). Similar findings were observed for total shoulder arthroplasty and arthroscopic rotator cuff repair patients (increase by 25.7% and 34.4%, respectively, $p<0.001$).

DISCUSSION AND CONCLUSION: E-mail completion of PROMs serves as a mechanism to increase the completeness of follow-up data in the absence of in-office patient evaluation.

Wearing ID Badges in the Operating Room Environment: Is Reconsideration Warranted?

Abstract ID: Paper 237

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INTRODUCTION: Surgical site infection and nosocomial infections in general have appropriately undergone increased scrutiny over the last decade. Numerous studies have documented bacterial contamination of personal items such as cell phones, beepers, ties, and pens in the hospital setting. It is our understanding that JCAHO requires all personnel to wear an identification badge at all times which includes the operating room environment. The purpose of this study was to evaluate the bacterial contamination of ID badges worn in the operating room. The authors hypothesized a high incidence of bacterial contamination would be present on the badges of operating room personnel.

METHODS: Badges, lanyards, and pagers from operating room personnel were swabbed and cultured using the same protocol used for surgical specimens in the operating rooms. Personnel included orthopedic attendings (14), orthopedic residents (20), nurses (19), and anesthesia personnel (11).

RESULTS: A total of 64 badges were sampled, with no MSSA or MRSA cultured on any of the badges. Only 2/64 had enterococcus (3%), and 1 of those was vancomycin resistant. Pagers had similar results, with only 1/42 growing MSSA or enterococcus (2.4%), and no MRSA. Lanyards, however, showed slightly higher rates of contamination. There were 11% with MSSA or MRSA out of 27 sampled. Highest contamination rates were with orthopedic staff and resident lanyards, with 3/22 (13.6%) growing MSSA or MRSA. No lanyards grew enterococcus. When comparing rates of MSSA/MRSA between groups, lanyards had a statistically significant higher rate ($p < 0.01$).

CONCLUSIONS: Relatively few bacteria (especially staph pathogens) were cultured from the badges (8.5%, no staph organisms) and pagers (18.6%, only one staph organism) of operating room personnel; however, 20.6% of lanyards cultured positive and 60% of these were staphlyococcal organisms. At a minimum, operating room personnel should probably not use lanyards to display their ID badges.

Comparison of Microbial Count on Various Surfaces in Operating Rooms at Different Times of the Day

Abstract ID: Paper 238

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INTRODUCTION: Surgical site infections (SSIs) are hospital acquired infections (HAIs) occurring within 30 days of surgery and account for 14- 20% of all HAIs in surgical patients. Factors such as microbiological contamination of air and various surfaces in the operating room (OR) have not been fully studied as possible risk factors for SSIs. The purpose of this study was to determine the degree of microbial contamination of surfaces in the OR and to understand the relationship between time and location of contamination.

METHODS: Five OR surfaces (surgical staff keyboard, surgical staff mouse, OR lights, underside of the surgical table, and anesthesia keyboard) were sampled at two time points (6am and 3pm) on 3 consecutive Mondays and Thursdays. Locations were swabbed 3 times at each sampling. Each swab was streaked on one quadrant of a 5% sheep blood Columbia agar plate. Swabs that grew 4 or more CFU without broth were considered +2 positive for growth. Swabs were then introduced to a liquid nutrient broth to further facilitate growth after which, if present, was considered +1 growth. Descriptive statistics and chi-square analyses were performed to assess differences in contamination.

RESULTS: Overall, 180 swabs were collected from the same OR; 90 specimens from each time and 30 from each day. A total of 72 swabs (42%) exhibited some level of bacterial growth. At the 6am time point, 58.9% (53) had no growth. Of the remaining 41.1%, 23.3% (21) had +2 growth and 17.8% (16) had +1 growth. At the 3pm time, 55 (61.1%) had no growth, 23 (25.6%) displayed +2 growth and 12 (13.3%) showed +1 growth. The most sterile surface was the OR lights with only 1 positive growth sample at each time. At both times, the most commonly contaminated surface was the staff keyboard (29). There were no significant differences in total growth between two times or locations. The majority of CFUs (60 of 72) were identified as coagulase negative staphylococcus species. Otherwise, cultures grew bacillus species (8 times), diptheroid species (3 times), and 1 instance of micrococcus.

CONCLUSIONS: Efforts to minimize SSIs can have a tremendous impact on hospital resource utilization. Our results demonstrated a 42% contamination rate of OR surfaces which is not impacted by time of day or day of the week and most commonly occurred on the staff keyboard. Simple cleaning and daily decontamination of staff keyboards can significantly reduce bacterial burdens and should be of primary importance to optimize OR sterility.

HIP

Incidence, Risk Factors, and Clinical Implications of Pneumonia Following Total Joint Arthroplasty

Abstract ID: Poster 001

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INTRODUCTION: The purpose of this study is to determine the incidence, risk factors, and clinical implications of pneumonia following total joint arthroplasty (TJA).

METHODS: The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) was used to conduct a retrospective cohort study of patients undergoing TJA. Independent risk factors for the development of pneumonia within 30 days of TJA were identified using multivariate regression. Mortality and readmission rates were compared between patients who did and did not develop pneumonia using multivariate regression that adjusted for all demographic, comorbidity, and procedural characteristics.

RESULTS: In total, 171,200 patients met inclusion criteria, of whom 66,493 (38.8%) underwent THA and 104,707 (61.2%) underwent TKA. 590 patients developed pneumonia, yielding a pneumonia incidence of 0.34% (95% confidence interval = 0.32-0.37%). Independent risk factors for pneumonia were older age, male sex, lower body mass index, dependent functional status, current smoker status, chronic obstructive pulmonary disease, hypertension, dyspnea on exertion, and diabetes mellitus ($p<0.05$ for each). Patients who developed pneumonia following discharge had a higher readmission rate (82.1% versus 3.4%, adjusted relative risk [RR] = 16.6, $p < 0.001$) and a higher mortality rate (3.7% versus 0.1%, adjusted RR = 19.4, $p < 0.001$). Among 124 total mortalities, 22 (17.7%) occurred in patients who had developed pneumonia.

CONCLUSIONS: Pneumonia is a serious complication following TJA that occurs in approximately 1 in 300 patients. Approximately 4 in 5 patients who develop pneumonia are subsequently readmitted, and approximately 1 in 25 die. Given the serious implications of this complication, evidence-based pneumonia prevention programs including oral hygiene with chlorhexidine, sitting upright for meals, elevation of the head of the bed to at least 30°, aggressive incentive spirometry, and early ambulation should be implemented for patients at greatest risk.

Minimum 25-Year Follow-Up of a Cementless Anatomic Femoral Design: As Good As a Cemented Fixation?

Abstract ID: Poster 002

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INTRODUCTION: Although not all first generation cementless femoral designs performed well, those with circumferential coating, adequate sizing and torsional stability demonstrated excellent mid-term durability. The purpose of the present study was to evaluate a first generation cementless anatomic femoral design at minimum 25-year follow-up and to compare those results to the author's 25-year results with cemented THR.

MATERIALS AND METHODS: 100 consecutive cementless THAs were performed in 91 patients and followed for a minimum of 25 years. There were 62 men and 29 women. Average age was 58 years. Patients were evaluated for revision of components, radiographic loosening, and osteolysis and with Harris Hip ratings.

RESULTS: At 25 to 30 year follow-up, 23 patients (24 hips) were found to be living, 67 (75 hips) were deceased, and one (1 hip) was lost to follow-up. In living patients, 53% of acetabular components and 4.3% of femoral components revised for loosening and/or osteolysis. For all patients, 22% of acetabular components and 7% of femoral components were revised for loosening and/or osteolysis. One additional femoral component demonstrated radiographic loosening. In addition, one acetabular component was revised for an acute postoperative dissociation and one femoral component was revised for traumatic periprosthetic fracture.

CONCLUSION: At minimum 25-year follow-up, only 7% of femoral components were revised for loosening with one additional component radiographically loose, which is comparable to the 2 to 6% revision rates and 10% radiographic loosening rates of the most successful cemented femoral components utilized at the same time interval (as reported by the present authors). The circumferential coating, multiple sizes (7), and torsional stability of this anatomic design probably account for the durability of this stem. The high osteolysis rate is probably related to the use of 32 mm heads and gamma in air polyethylene.

SUMMARY: At minimum 25-year follow-up, only 7% of femoral components were revised for loosening and/or osteolysis, a rate comparable to the most successful cemented stem designs.

The Incidence and Clinical Significance of Noise Generation in Young Hip Arthroplasty Patients

Abstract ID: Poster 003

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INTRODUCTION: Patient-perceived noise from prostheses after total hip arthroplasty (THA) occurs, yet questions remain including its overall frequency, demographic and prosthesis-related factors, and its association with symptoms.

METHODS: A five-center, retrospective investigation of patients who received a primary THA with an age < 60 years, a pre-symptomatic UCLA score of > 6, and a minimum of 1 year clinical follow-up was performed. Data was collected by an independent, blinded, third-party survey center who administered a previously published survey instrument to assess patient-perceived noise generation, symptoms, and function. Differences in demographic variables were accounted for using multiple logistic regression analyses and Pearson's correlation coefficients were used to determine the association of noise generation with symptoms.

RESULTS: Six hundred and eighty-two patients (mean age 50 + 8 years; mean follow-up 3 + 1 years; 63% male) were included. Bearing surfaces (femoral head-acetabular liner) included 31% metal-on-metal, 21% ceramic-on-ceramic, 21% ceramic-on-polyethylene, 21% cobalt-chromium-on-polyethylene, and 6% oxidized zirconium-on-polyethylene.

Overall, 9% of young patients undergoing primary THA reported noise generation. Females (12%) were noted to have an increased likelihood of reporting noise versus males (7%; OR 1.8; $p = 0.03$). After controlling for potential confounders including gender and length of follow-up, patients receiving a ceramic-on-ceramic or metal-on-metal bearing surface (14%) reported an increased frequency of grinding, popping, and clicking in the 30 days before survey administration versus those receiving a polyethylene liner regardless of femoral head composition (3%; OR 5.6; $p < 0.001$). Noise generation was associated with increased pain ($r = 0.23$, $p < 0.001$) and stiffness ($r = 0.22$, $p < 0.001$) after THA.

CONCLUSION: When interviewed by an independent third party survey center, patients receiving a hard-on-hard bearing reported a higher frequency of noise generation after THA. Noise generation after THA is associated with increased pain and stiffness in young, active patients.

Analysis of Outcomes Following THA: Do All Databases Produce Similar Findings?

Abstract ID: Poster 004

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INTRODUCTION: Use of large database for orthopedic research has increased exponentially. Each database represents unique patient populations and vary in methodology of data acquisition. The purpose of this study was to evaluate differences in reported demographics, comorbidities, and complications following total hip arthroplasty (THA) amongst four commonly used databases.

METHODS: Patients who underwent primary THA during 2010-2012 were identified within National Surgical Quality Improvement Programs (NSQIP), Nationwide Inpatient Sample (NIS), Medicare Standard Analytic Files (SAF), and Humana Claims Database (HCD). NSQIP definitions for comorbidities and surgical complications were matched to corresponding ICD-9 and CPT codes and these coding algorithms were used to query NIS, SAF, and HCD. Age, sex, comorbidities, inpatient, and 30-day postoperative complications were compared (NIS has inpatient data only) using standard statistical techniques.

RESULTS: The number of primary THA patients from each database was 22,644 in HAC, 371,715 in SAF, 188,779 in NIS, and 27,818 in NSQIP. All databases were similar in their gender (1.3-1.6:1 female to male) and age distribution; however, patients in HAC and SAF were slightly older.

Overall, there was variation in prevalence of comorbidities and rates of postoperative complications between databases. As an example, NSQIP had more than twice the obesity than NIS. HAC and SAF had more than two times the diabetics than NSQIP. Rates of deep infection and stroke 30 days after THA had more than twofold difference between all databases. HAC had more than twice the rate of 30-day deep infections and deep vein thrombosis (DVT) than SAF.

CONCLUSIONS: Amongst databases commonly used in orthopedic research, there is considerable variation in complication rates following THA depending upon the database used for analysis. It will be important to consider these differences when critically evaluating database research. Additionally, with the advent of bundled payments, these differences must be considered in risk adjustment models.

Are Trends in THA Bearing Surface Continuing to Change? A Look at 2007-2015

Abstract ID: Poster 005

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INTRODUCTION: Bearing surface issues related to trunionosis or metal-on-metal (MoM) articulations have likely impacted trends in bearing surface choice. The purpose of this study was to evaluate trends in THA bearing surface use, including 2015 data, with respect to date of operation, patient demographics, and geographic location.

METHODS: The Humana Inc. administrative claims dataset was reviewed from 2007 to second quarter of 2015 to analyze bearing surface usage in primary THA. Four bearing surface types were identified by ICD-9 procedure codes and included metal-on-polyethylene (MoP), ceramic-on-ceramic (CoC), ceramic-on-polyethylene (CoP), and MoM. The use of each bearing type was trended throughout the years of the dataset. The prevalence of each bearing surface was calculated and compared amongst subgroups based upon patient age, sex, and geographic locations.

RESULTS: 26,824 primary THA procedures were analyzed. The most commonly used bearing was MoP (46.6%) followed by CoP (32.0%), MoM (17.8%) and CoC (3.6%). The use of CoP bearings significantly increased form 6.3% in 2007 to 51.4% in 2015. There was a corresponding decrease in MoM bearings over this time period as well as MoP bearings over 2012-2015 ($p<0.001$ for both). As patients aged, there was a decrease in use of CoP and an increase in use of MoP with this transition occurring at 65-69 years of age. There were large regional variations in bearing surface choice, with the most pronounced differences between MoP and CoP use.

CONCLUSIONS: Bearing surface choices in the setting of primary THA have changed tremendously from 2007 to 2015 with considerable variation based upon patient characteristics and geographic location. The decreased use of MoM and MoP are likely a result of recently reported issues related to metal articulations. Further research is needed to determine if the observed variations in bearing surface based upon patient demographics and geographic location are warranted.

Recent Trends in Blood Transfusion After Primary THA

Abstract ID: Poster 006

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INTRODUCTION: Blood preservation strategies have evolved greatly over the last five years to include lowering trigger points for transfusion, specific hydration protocols, and use of anti-fibrinolytics. In addition, transfusion rates are now being used as a quality indicator, especially in high volume procedures such as total hip arthroplasty (THA). There is a paucity of large database longitudinal blood utilization studies in joint arthroplasty that include recently performed surgery. The purpose of this study was to utilize a large multicenter database to evaluate trends in blood transfusion rates following primary THA, including early 2015 data.

METHODS: The Humana Inc. administrative claims dataset was reviewed from 2007 to second quarter of 2015 for patients undergoing primary THA. This dataset represents over 20 million lives and includes private insurance and Medicare/Medicare Advantage plans. THA procedures were identified by ICD-9 and CPT codes and blood transfusions within 5 days of surgery were identified by the following ICD-9 codes: 99.00 (perioperative autologous blood), 99.02 (preoperative collected autologous blood), and 99.04 (allogeneic blood). Blood transfusion rates were calculated and trended by year for the dates included in the dataset. Trends in type of transfusion were also analyzed. Comparisons were made with odds ratios (OR) and 95% confidence intervals.

RESULTS: In total 66,501 patients who underwent primary THA were analyzed. Overall, 12,421 patients (18.7%) required a blood transfusion within 5 days of THA and 54,080 patients did not (81.3%). The most common type of blood transfused was allogeneic packed red blood cells (88.5% of all transfusions) followed by perioperative collected autologous blood (11.5% of all transfusions). There were no transfusions of preoperatively collected autologous blood in this study. Transfusion rates following THA peaked in 2010 (24.7% transfusion rate) and dropped significantly over the remaining years (OR:3.2 [2.9-3.5], $p<0.001$) to 9.4% in 2015. Rates of perioperative collected autologous blood ranged from 9.8-15.6% of transfusion during the years of this data.

CONCLUSIONS: Rates of blood transfusion within 5 days of THA have fallen precipitously since 2011 and are now less than 10%. Transfusion of preoperatively donated blood appears to no longer be in use; however, approximately one-tenth of transfusion are of perioperative collected blood. Blood management strategies instituted over the last five years have had a large impact on transfusion rates following THA.

Eighty-Six Percent Failure Rate of a Modular-Neck Femoral Stem Design at 3 to 5 Years: Lessons Learned

Abstract ID: Poster 007

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BACKGROUND: While innovation drives advancement, it is not immune to failure. Previously, we reported a corrosion-related revision rate of 28% (23 of 81 total hip arthroplasties) among patients who received the Rejuvenate modular-neck stem implant with short-term follow-up. Because we observed a dramatic interval failure rate after our initial report, we undertook this study.

METHODS: We prospectively followed a cohort of patients who had undergone implantation of the Rejuvenate modular-neck stem, as previously reported. At a minimum of 3 years of follow-up (range, 3.0 to 5.5 years), 73 hips in 63 patients (90% of the original group) were available for analysis. The mean serum cobalt and chromium ion levels were obtained preoperatively and postoperatively. Elevated serum cobalt ion levels (>4 µg/L), pain, or abnormal magnetic resonance imaging (MRI) findings were indications for revision surgery. Patient factors and serum metal ion levels were correlated to revision surgery. Additionally, post-revision serum cobalt and chromium ion level trends were assessed.

RESULTS: An 86% clinical failure rate (63 of the 73 hips) was observed at a mean follow-up of 4.2 ± 0.6 years (range, 3.0 to 5.5 years); 57 (78%) of the hips underwent revision at a mean of 3.2 ± 1.0 years (range, 1.0 to 5.5 years), and 6 (8%) of the hips were scheduled for revision. Patients who underwent revision surgery were younger and had greater serum metal ion levels and greater pain compared with patients who did not undergo revision. An elevated serum cobalt ion level was the most important independent factor associated with revision surgery. Cobalt ion levels decreased sharply after revision; however, some patients demonstrated persistent elevation with more gradual decline.

CONCLUSIONS: Emphasizing the reporting of positive results may leave orthopedic surgeons reticent to publicize negative results; however, the high failure rate of this implant design within 5 years prompted this report. We believe that patients and orthopedic surgeons should be made aware of this implant's clinical problems and patients should be followed closely. Expedient revision is necessary when failure is identified, to minimize potentially severe tissue damage and metal toxicity.

Assessing the Impact of Body Mass Index on Complications Following Total Joint Arthroplasty: Statistical Methods Dictate Results

Abstract ID: Poster 008

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INTRODUCTION: Elevated Body Mass Index (BMI) is an established risk factor for complications following total joint arthroplasty (TJA). Various stakeholders have proposed BMI cutoffs for those seeking TJA, making accurate delineation of the effect of BMI a necessity. The optimal statistical methods to model risk attributable to BMI have not been well defined.

METHODS: Using TJA cases from the National Surgical Quality Improvement Project (NSQIP) dataset from 2005-2012, we investigated risk of complications specifying BMI in three ways: (1) as a categorical variable by the World Health Organization (WHO) BMI classes, (2) as an ordinal variable by truncating BMI to the next lowest integer, and (3) as a continuous variable using restricted piecewise cubic splines. A parsimonious model was created and regression analyses were performed to assess the impact of BMI on risk for Centers for Medicare and Medicaid services (CMS) reportable – complications. Results were then compared for different specifications of BMI.

RESULTS: 82,007 TJA cases were available of inclusion (50,380 TKA; 31,627 THA). The overall rate of CMS-reportable complications was 6.1%. The different methods of specifying BMI led to divergent results regarding BMI as a risk factor: specification of BMI by World Health Organization (WHO) classes showed significantly higher risk for the BMI 30-35, BMI 35-40, and BMI >40 cohorts compared to the lower BMI cohorts ($p<0.05$ for all comparisons); specification of BMI as a continuous variable showed a smooth risk curve with poor fit by categorical WHO BMI classes; specification of BMI as ordinal integers showed risk outliers across the spectrum of BMI and interquartile risk ranges that included the sample mean for all BMI < 44, with overlapping 95% confidence intervals for all adjacent BMI values.

CONCLUSION: The statistical methods used to model the effect of BMI on post-arthroplasty complications dictate the results. World Health Organization categorization of BMI leads to an arbitrary risk cutoff off at 40 which is not supported by more in-depth analysis of BMI as a risk variable. Post-surgical risk of complication as a function of increasing BMI is gradual, non-linear and is not related to risk in a manner that supports the concept of a surgical cutoff.

Patient Perceptions Regarding Outpatient Hip and Knee Arthroplasty

Abstract ID: Poster 009

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INTRODUCTION: There is concern that surgeons and financial incentives are driving an expedited transition into the outpatient setting, which may not be enthusiastically embraced by patients. The purpose of this study was to determine patient perceptions regarding outpatient hip and knee replacement.

METHODS: In a suburban, academic-affiliated arthroplasty practice offering inpatient and outpatient surgery, all patients deemed appropriate for primary hip or knee replacement were offered a 16-question survey regarding their existing knowledge and perceptions of outpatient surgery. The survey was administered prior to any discussion of surgery location or length of stay expectations. No mention of outpatient or same day discharge occurred prior to the survey.

RESULTS: 110 consecutive patient questionnaires were available for analysis (98% response). 57% of patients were female and 43% were 65 years or older. 55% (n=60) of patients had knowledge of outpatient hip or knee replacement surgery. 34% of patients responded being comfortable with discharge home same day or within 23 hours, 33% were unsure, and 32% were uncomfortable. A greater percentage of men (55%) were comfortable with the outpatient setting (p=0.03). Patients 50 or younger (83%) felt the outpatient setting would facilitate faster recovery (p=0.05) and 73% of all patients responded it would reduce hospital-acquired infection risk (p=0.05). 61% of patients felt total joint arthroplasty was appropriate for outpatient, whereas 39% responded that partial replacement only was appropriate. 52% responded hospitals and ASC's are equally safe, while 37% of patients felt hospitals were safer.

CONCLUSION: While outpatient joint replacement is raising some concerns, this data supports more than 50% of patients may be aware of the option, feel hospitals and ASC's are equally safe, that total hip and knee arthroplasty is appropriate, and that the outpatient setting may reduce infection risk. However, there is ample opportunity for patient education on this topic.

Hip Fractures Treated with Total Hip Arthroplasty: Incidence and Risk Factors for Surgical Delay

Abstract ID: Poster 010

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INTRODUCTION: Hip fractures are common with total hip arthroplasty (THA) at times being the treatment of choice. Surgical delay has been associated with increased morbidity, mortality, and overall cost in various orthopedic patient populations. Understanding of modifiable risk factors for surgical delay in the context of hip fractures treated with THA would aid surgeons in optimizing patients for the operating room. Knowledge of non-modifiable risk factors for surgical delay would allow for comparison of different surgeons, healthcare systems, and patient populations. The purpose of this investigation was to (1) define the incidence of surgical delay when treating hip fractures with THA and (2) identify risk factors for surgical delay in the setting of hip fractures receiving THA.

METHODS: The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database was queried for patients age 60 years or older undergoing hip arthroplasty (CPT 27130) for a hip fracture between 2005 and 2010. Surgical delay was defined as time from hospital admission to operative intervention. Univariate and subsequent multivariate analysis were conducted.

RESULTS: Of 176 patients who met inclusion criteria, 138 (78.4%) experienced surgical delay of ≥1 day, 72 (41%) had delay of ≥2 days, and 30 (17%) experienced delay of ≥3 days. There were no differences in overall complications dependent on time to operative intervention. Multivariate analyses identified bleeding disorder (odds ratio [OR], 12.94; 95% confidence interval [CI], 1.41-118.81), creatinine >1.4 (OR, 8.14; 95% CI, 1.96-33.84), and dependent functional status (OR, 2.79; 95% CI, 1.15-6.78) as risk factors for surgical delay ≥1 day. Risk factors for delay of ≥2 days included BMI ≥ 30 (OR, 4.92; 95% CI, 1.68-14.39) and dependent functional status (OR, 2.83; 95% CI, 1.33-6.02). Risk factors for delay of ≥3 days included BMI ≥ 30 (OR, 8.27; 95% CI, 1.74-39.38), dependent functional status (OR, 6.91; 95% CI, 1.74-27.43), and bleeding disorder (OR, 3.84; 95% CI, 1.002-14.74).

DISCUSSION AND CONCLUSION: Creatinine >1.4 was found to be a modifiable risk factor for surgical delay. Surgeons can implement preoperative protocols to identify and optimize patients with elevated creatinine in an effort to achieve timely operative intervention. Non-modifiable risk factors for delay include BMI ≥ 30, bleeding disorders, and dependent functional status. Healthcare systems can utilize these non-modifiable risk factors when assessing quality measures amongst individual surgeons and hospitals.

Total Hip Arthroplasty in Patients with Dwarfism: A Long-Term Outcome Study

Abstract ID: Poster 011

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BACKGROUND: Short stature and skeletal deformity within the hip are commonly encountered in patients with osteochondrodysplasias (dwarfism). This patient population often develops significant degenerative joint disease, decreased function, and debilitating pain, typically at an early age. Total hip arthroplasty (THA) is known to be an effective treatment modality; however, there remains a significant hesitation due to fears of increased postoperative complication and revision rates. Currently there is a paucity of long-term outcome data on the use of THA in this patient population. The purpose of this study was to review our institution's outcome of THA performed on patients with dwarfism, focusing specifically on rates of postoperative complications, reoperation, and revision.

METHODS: Following IRB approval, we retrospectively reviewed our institution's total joint registry and the medical records of 41,349 patients who underwent a primary THA during a 43-year period (1970-2013). Of those, 148 THAs (0.35%) were performed in patients with dwarfism. The cohort consisted of 52% female. Mean age, BMI, and height were 39 years, 28.7 kg/m^2, and 145 cm, respectively. All patients were ambulatory. Mean follow-up was 11 years (up to 40 years). Harris Hip Scores (HHS) were calculated preoperatively and at final follow-up.

RESULTS: The mean implant survival for primary THA in this patient population was 94%, 85%, 52%, and 33% at 5-, 10-, 20-, and 30-year, respectively. In an analysis of risk factors for revision, patients < 40 years of age were at significant increased risk for revision THA (HR 2.45, P=0.01). The most common indication for revision THA was aseptic loosening (n=41). Eight patients underwent reoperation, most commonly to remove painful hardware (n=6). Following THA, 66 patients (44%) sustained at least 1 postoperative complication, most commonly acetabular polyethylene wear (n=18). Prior to surgery, 93% of patients had moderate to severe pain affecting their quality of life, and this was reduced (P <0.0001) to 10% postoperatively. The mean HHS improved (P<0.0001) from 44 to 82 at final follow. Prior to surgery, 40% of patients ambulated without assistance of a gait aid, and this improved (P<0.0001) to 60% postoperatively.

CONCLUSION: Following THA, there was a high incidence of complications in patients with osteochondrodysplasia, likely related to young patient age and increased dysplasia at the time of surgery. However, THA provided significant pain reduction and improved patient function, with a majority of patients able to ambulate independently following the procedure.

Dislocation Following Two-Stage Revision Total Hip Arthroplasty: Alarming Concern is Warranted

Abstract ID: Poster 012

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INTRODUCTION: While two-stage exchange total hip arthroplasty (THA) is an effective eradication treatment for periprosthetic hip infections, hip dislocations continue to be a major concern. In 2016, there remains a paucity of literature on risk factors for dislocation after hip reimplantation. As such, we sought to examine the incidence of, and associated risk factors for, hip instability following two-stage exchange arthroplasty for periprosthetic hip infections, as well the fate of reimplanted hips that dislocate.

METHODS: 516 two-stage exchange THAs (503 patients) performed between 2000-2014 were retrospectively reviewed at a single institution. Risk factors assessed included patient demographics and surgical factors. Postoperative complications, reoperations, and revisions were analyzed as time-to-event outcomes utilizing survivorship methodology, including Kaplan-Meier estimation and Cox proportional hazards regression. The impact of dislocation on these outcomes was evaluated as a time-dependent covariate. Mean age at the time of reimplantation was 65 years, with a mean follow-up of 4 years.

RESULTS: Dislocations occurred in 50 hips following reimplantation (9.3% at 1 year). Of those who developed instability, 60% dislocated within the first three months after surgery and 86% dislocated within one year of the reimplant. There was a trend toward a higher risk of instability in females (HR 1.7, p=0.07). Younger age (HR 1.1, p=0.19), BMI (HR 1.0, p=0.48), and number of previous surgeries (HR 1.2, p=0.09) were not significant risk factors. Hips reconstructed with a dual-mobility construct demonstrated a trend toward a lower risk of dislocation (HR 0.31, p=0.25). Surgical approach, head size, spacer type, and the use of a constrained liner did not significantly impact the risk of instability ($p > 0.05$ for all). Risk of additional complications (HR 3, p=0.0007), reoperations (HR 33, $p<0.0001$), and revision surgery (HR 27, $p<0.0001$) were all significantly higher in patients who experienced a dislocation compared to those who did not dislocate after their reimplantation.

CONCLUSIONS: Dislocation after two-stage exchange THA continues to be a major concern with the incidence approaching 10%. While no definitive patient or surgical risk factors were identified, the fate of this difficult cohort is poor.

SUMMARY: Dislocation after contemporary two-stage exchange THA occurs in 10% with an alarming 33-fold increased rate of re-reoperation and 27-fold increased rate of re-revision if dislocation occurs.

Quantifying Blood Loss and Transfusion Risk Following Primary vs. Conversion Total Hip Arthroplasty

Abstract ID: Poster 013

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INTRODUCTION: While most studies have focused on perioperative blood loss and transfusion in primary and revision THA, there is scant literature on conversion THA. Various metrics are used to evaluate blood loss (e.g., estimation, calculation-based, transfusion requirement), none are exact and each has its own assumptions. This study's aims were to compare both blood loss and transfusion rates in primary and conversion THA and identify predictors associated with each.

METHODS: All primary and conversion THA (n=1,796) performed at a single institution between 2009-2013 were reviewed. N=1,616 patients were analyzed (n=1,575 primaries and n=41 conversions). Data was collected from electronic records. Blood loss was calculated using a validated method based on perioperative changes in hematocrit compared to initial blood volume. Transfusion triggers were based on standardized criteria: hemoglobin ≤ 6.9g/dL or < 8g/dL in those remaining symptomatic and/or have changes in vital signs despite fluid resuscitation. Separate multivariable regression models for blood loss and transfusion were both adjusted for potential confounders including demographic, clinical and perioperative information.

RESULTS: Patients with conversion THA were younger (p=0.002), had lower Charlson comorbidity-scores (p=0.006), longer surgeries (p<0.001), higher blood loss (p<0.001), and more transfusions (p<0.001). There were differences between primary and conversion THA in terms of surgical approach (p<0.001), anesthesia-type (p<0.001), and VTE prophylaxis (p=0.01). After adjusting for risk factors, conversion THA had 440.29 mL higher total blood loss compared to primary THA (p=0.0085). Also, increased blood loss was associated with increasing age (5.64 mL per year increase,p=0.0003), increased procedure time (6.5 mL per unit increase,p<0.0001), and posterior compared to direct lateral approach (218.29 mL increase in blood loss,p<0.0001); decreased total blood loss was associated with increased preoperative hemoglobin (-79.15 mL per unit increase,p<0.0001) and increased preoperative platelets (-1.27 mL per unit increase,p<0.0001). Anesthesia type was not significant (p=0.52). For transfusion risk, conversion THA had significantly increased odds of requiring a transfusion compared to primary THA (OR=3.05,p=0.026). Other significant variables for transfusion were age (OR=1.03,p<0.0001), BMI (OR=0.95,p<0.0001), preoperative hematocrit (OR=0.78,p<0.0001), procedure time (OR=1.02,p<0.0001), and posterior versus direct lateral approach (OR=1.74,p=0.0004); anesthesia type was not significant (p=0.18). Similar risk factor patterns emerged for both metrics (i.e., blood loss and transfusion).

CONCLUSION: Conversion THA leads to higher blood loss and transfusion rates compared to primary THA. These differences were quantified in the present study, and showed consistent

results between the two metrics. There is a clear difference between these two procedures that should be addressed during quality assessment and reimbursement.

Intraoperative Periprosthetic Acetabular Fractures in 33,000 Primary THAs

Abstract ID: Poster 014

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INTRODUCTION: Intraoperative periprosthetic acetabular fractures are known to occur during THA, but there is little information about risk factors for occurrence, optimal methods of treatment and consequences of these fractures on cup fixation. The aim of this investigation was to study risk factors, treatment methods, and associated outcomes of intraoperative periprosthetic acetabular fractures.

METHODS: We identified all intraoperative periprosthetic acetabular fractures occurring during primary THA from 1969-2011 at an academic institution. Fractures were analyzed based on demographics, timing, and type of fracture. Radiographs and the medical records were reviewed to characterize the fractures, treatment modalities, and determine results.

RESULTS: There were 32,644 primary THAs performed during the study period with 68 intraoperative periprosthetic acetabular fractures identified (incidence = 0.21%). Sixty-two occurred with placement of a press-fit acetabular component (91%). Intraoperative fractures were significantly more common with the use of press-fit acetabular components (OR 9; $p<0.001$) and in females (OR 2; $p=0.003$). The majority of intraoperative fractures occurred during placement of the final acetabular component (75%), and most commonly involved the posterior-superior acetabular rim (38%) or posterior wall (33%). The most common treatments were bone grafting at the fracture site (60%) and placement of supplemental acetabular component screws after the fracture was recognized (37%). However, 9 acetabular components (13%) required a larger uncemented hemispherical acetabular component and 1 (1.5%) fracture required ORIF with a plate. At most recent follow-up (mean 10 years), no hips had required further surgery for aseptic acetabular component loosening or acetabular fracture nonunion.

CONCLUSION: Intraoperative periprosthetic acetabular fractures occur with a low incidence (0.21%), but are significantly more common with press-fit acetabular components (9-fold) and in females (2-fold). Most of these fractures involve the posterior acetabular rim or posterior wall and can successfully be treated with supplemental screw fixation when needed.

Navigated Total Hip Arthroplasty: Early Complications, Utilization, and Patient Demographics

Abstract ID: Poster 015

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INTRODUCTION: Introduction of new technology requires close surveillance to determine its value. The purpose of this study was to determine the adoption rate of computer-navigated THA and the short-term complications compared to THA performed without navigation, while controlling for demographic differences in the navigated cohort.

METHODS: The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database was used to identify 46,503 patients undergoing THA from 2010 to 2013. Common Procedural Terminology (CPT) codes were used to identify cases of navigated and traditional THA. Rates of adoption of the computer-navigated THA were determined. Propensity matching was used to account for demographic differences between cohorts. Univariate and multivariate analyses were performed to determine differences in outcomes while identifying risk factors for morbidity.

RESULTS: Patients having THA with navigation had a lower ASA class ($p<0.0001$), were more likely to be white ($p<0.0001$), and less likely to be obese ($p<0.0001$), smoke ($p<0.0001$), or have diabetes ($p<0.0001$). 2.4% of THAs were completed with navigation. After controlling for comorbidities using propensity matching, length of stay was significantly decreased in the navigated group (2.4 days versus 3.6 days, $p<0.0001$). There was a decreased transfusion rate in the navigated group (6.74% versus 14.93%; $p<0.0001$). Operative time was longer in the navigated group (102.8 minutes versus 98.0 minutes, $p=0.0064$). There were no significant differences between groups for all cause complications or unplanned readmissions.

CONCLUSIONS: Computer-navigated THA is being selectively implemented in a healthier population as compared to traditional THA. After controlling for comorbidities with propensity matching, navigated THA had decreased length of stay, decreased transfusion rates, and increased operative time. There were no significant differences in all cause complications, reoperation, or readmission between groups. Over the four-year study interval, 2.4% of THA's were completed with navigation.

A Comparison of Total Hip Arthroplasty for Post-Traumatic Arthritis and Primary Osteoarthritis: Isn't it the Same Surgery?

Abstract ID: Poster 016

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PURPOSE: The purpose of this study was to compare implant placement and outcomes for total hip arthroplasty (THA) in post-traumatic arthritis (PTA) compared to primary osteoarthritis (OA).

MATERIAL AND METHODS: A retrospective chart review identified 43 patients who underwent THA for PTA. Data included demographics, preoperative and postoperative radiographic measurements, operative variables, and complications. The patients were matched with OA controls based on age, gender and ASA score.

RESULTS: The demographics of our matched cohorts were similar. Preoperative deformity was worse in the PTA group (PTA LLD -13.6 mm vs. OA -4.0 mm; P-value 0.00). THA in PTA was more complex with longer OR times (156.8 min PTA vs. 104.6 min OA; P-value 0.014) with increased blood loss (PTA 413.6 mL vs. OA 287.9 mL; P-value 0.007) and transfusion rates (PTA 9 transfusions vs. OA 1 transfusion; P-value 0.00). 18.6% of PTA cases required hardware removal. There was a higher complication rate in PTA (25.5% PTA vs. 9.3% OA, P-value 0.00). Despite this, we were able reconstitute limb length, femoral offset, total offset, and acetabular position to similar angles as OA.

CONCLUSION: This is the first study of this nature to directly compare the hip reconstruction of PTA and OA patients in a matched cohort. Previous studies have found that THA in PTA leads to increased blood loss, operative time, infection, and postoperative complications which we confirmed. Hardware removal is frequently required and surgeon needs to be prepared for this. Despite these challenges, we have shown that reconstruction of acetabular and femoral anatomy is possible in this population but with an increased early complication profile. This increased complication rate is an important issue of concern as arthroplasty moves towards a bundled payment model.

The Influence of Patient Gender on Morbidity Following Total Hip or Total Knee Arthroplasty

Abstract ID: Poster 017

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INTRODUCTION: Little research has focused on the influence of gender on postoperative morbidity following total hip arthroplasty (THA) and total knee arthroplasty (TKA). The present study aimed to compare operative time, length of stay, 30-day complications, and readmissions based on patient gender.

METHODS: The prospectively collected National Surgical Quality Improvement Program registry from 2005 through 2014 was queried to identify primary elective THA and TKA patients. Multivariate Poisson regression with robust error variance was used to compare the rates of 30-day adverse events and readmission between males and females. Multivariate linear regression was used to compare operative time and postoperative length of stay. Multivariate analyses controlled for baseline patient characteristics and procedure type. A total of 173,777 patients were included in the study (63.5% TKA and 36.5% THA). The cohort was 48.9% male.

RESULTS: On multivariate analysis, male gender was associated with increased rates of multiple adverse events, including death (RR 1.1, $p<0.001$), surgical site infection (RR 1.2 $p<0.001$), sepsis (RR 1.4 $p<0.001$), cardiac arrest (RR 1.8, $p<0.001$), and return to the operating room (RR 1.3, $p<0.001$). Males had decreased overall adverse events (RR 0.8, $p<0.001$) and overall minor adverse events (RR 0.7 $p<0.001$) secondary to a lower risk of urinary tract infection (RR 0.5, $p<0.001$) and blood transfusion (RR 0.7, $p<0.001$) which were prevalent adverse events. Males had an increased risk of 30-day readmission (RR 1.2, $p<0.001$), slightly increased operative time (+6 minutes, $p<0.001$) and slightly decreased length of stay (-0.2 days, $p<0.001$).

CONCLUSION: Males had increased risk of multiple individual adverse events including death, surgical site infection, cardiac arrest, return to the operating room, and readmission. Conversely, females had increased risk of urinary tract infection and blood transfusion. Minor differences were found for operative time and postoperative length of stay, although these are unlikely to be clinically important.

Hip Arthroscopy for the Concurrent Treatment of Labral Tears and Femoro-Acetabular Impingement in Patients Younger than 50 Years Old: Minimum Five-Year Outcomes, Survivorship, and Risk Factors for Reoperation and Total Hip Arthroplasty

Abstract ID: Poster 018

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BACKGROUND: Literature reporting mid-term outcomes for patients aged < 50 years old undergoing hip arthroscopy to treat femoro-acetabular impingement (FAI) and labral tears is limited. This study reports minimum five-year patient-reported outcomes (PROs), survivorship, and risk factors for requiring revision arthroscopy or total hip arthroplasty (THA) for this demographic.

METHODS: Data were prospectively collected and retrospectively reviewed on 625 patients between February 2008 and December 2010. Inclusion criteria were age at surgery < 50 years, underwent arthroscopy for the concurrent treatment of FAI and labral tears, and documented preoperative modified Harris Hip Score (mHHS), Non-Arthritic Hip Score (NAHS), Hip Outcome Score – Sports Specific Subscale (HOS-SSS), and visual analog scale (VAS). Patients with Tönnis grade > 0, Legg-Calve-Perthes, dysplasia, SCFE, AVN, Workman's Compensation claims, or previous ipsilateral hip surgery were excluded.

RESULTS: Of 190 eligible cases, 153 hips (138 patients) had minimum five-year follow-up (80.5%, mean 70.5 months). Mean age was 30.3 years (range: 14.2, 49.5). Mean PROs and VAS demonstrated improvement at follow-up ($p < 0.0001$): mHHS (65.1, 82.9), NAHS (62.2, 85.2), HOS-SSS (46.4, 75), and VAS (6.0, 2.1). Mean satisfaction was 8.1. Twenty-four revisions were documented at a mean of 24 months. Risks for revision included female gender ($p = 0.002$) and lower preoperative mHHS ($p = 0.02$), NAHS ($p = 0.04$), and HOS-SSS ($p = 0.02$). Survivorship at minimum five-years was 90.2%, with 15 hips requiring conversion to THA at a mean of 34.5 months. THA risks included older age ($p < 0.0001$), higher BMI ($p = 0.01$), higher Tönnis angle ($p = 0.0007$), capsular release ($p = 0.05$), and lower preoperative mHHS ($p = 0.0008$), NAHS ($p = 0.001$), and HOS-SSS ($p = 0.02$).

CONCLUSIONS: Hip arthroscopy for the treatment of FAI and labral tears in patients aged < 50 years old demonstrates favorable mid-term outcomes. Several risk factors for requiring conversion to THA in this age group warrant cautious patient selection for arthroscopy.

Patient Reported Outcomes of Capsular Repair vs. Capsulotomy in Patients Undergoing Hip Arthroscopy: Minimum Five-Year Follow-Up. A Matched Cohort Study.

Abstract ID: Poster 019

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BACKGROUND: Capsulotomy and capsulectomy have been utilized to access the hip joint during arthroscopy. There has been an increasing interest in the role of capsular closure as opposed to capsular release pertaining to durability of hip arthroscopy procedures.

PURPOSE: This study aimed to elucidate what effect various capsular management strategies during hip arthroscopy might have on patient outcomes over the mid-term.

METHODS: Between February 2008 and February 2011, data were prospectively collected and retrospectively reviewed on patients undergoing hip arthroscopy for intra-articular pathology. Patients were then matched for age ± 5 years, gender, BMI ± 5, Workman's Compensation claim, and acetabular coverage. Inclusion criteria were: documented unrepaired capsulotomy or closure and lateral-center edge angle (LCEA) ≥ 18°. Exclusion criteria were previous ipsilateral hip surgery or hip conditions and preoperative Tönnis grade > 1. Patient-reported outcome scores (PROs) including modified Harris Hip Score (mHHS), Non-Arthritic Hip Score (NAHS), Hip Outcome Score-sport specific subscale (HOS-SSS), and Visual Analogue Score for pain (VAS) were collected preoperatively, at 3 months, and annually thereafter. Patient satisfaction was recorded from 0-10, with 10 being most satisfied. Complications, revisions, and conversion to arthroplasty were recorded.

RESULTS: Minimum five-year follow-up was available for 287 hips (259 patients, 82.5%) of 348 hips that met inclusion criteria. Of these 287 hips, 172 underwent unrepaired capsulotomy and 115 underwent capsular repair. Sixty-five capsular closure patients were matched in a 1:1 ratio to 65 capsular release patients. Both groups saw significant improvements in all mean PROs at latest follow-up. In the repair group, mean PROs, VAS, and patient satisfaction were significantly improved at two and minimum five-year follow-up. In the unrepaired group, there was significant decrease in mHHS ($p=0.001$) and patient satisfaction ($p=0.01$) between two- and five-year follow-up. More patients in the release group required conversion to hip arthroplasty (18.5 vs. 10.8%). The rate of revision arthroscopy was the same in both groups (15.4%). There was a low complications rate with 4.6% in the release group and 6.4% in the plication group.

CONCLUSION: This study demonstrates that patients undergoing hip arthroscopy can expect to have significant improvement at minimum five-year follow-up, whether or not the capsule is closed. However, patients who underwent capsular release had a significant deterioration in mHHS between two and five years postoperatively, and had a higher rate of conversion to arthroplasty. Decisions regarding closing the capsule versus capsulotomy or capsulectomy should be based on individual patient pathology.

Endoscopic Repair of Partial Thickness Undersurface Tears of the Abductor Tendon (PUSTA): Clinical Outcomes with Minimum Two-Year Follow-Up

Abstract ID: Poster 020

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BACKGROUND: The undersurface of the abductor tendon is a common location for tears. Endoscopic trans-tendinous repair has been previously described as a technique to both identify and treat these tears. There are currently no two-year outcome studies of this technique.

PURPOSE: To report the minimum two-year outcomes of trans-tendinous repairs of Partial thickness UnderSurface Tears of the Abductor (PUSTA) tendon using patient reported outcomes (PROs), visual analog scale (VAS), and patient satisfaction scores.

STUDY DESIGN: Level IV; Case series

METHODS: All patients who underwent endoscopic trans-tendinous gluteus medius repair between October 2009 and May 2013 at one institution were prospectively evaluated. Exclusion criteria consisted of less than two-year follow-up, previous hip surgery, inflammatory arthritis, open surgery, full thickness abductor tear, and worker's compensation patients. All patients had a documented preoperative physical examination with strength testing (0-5) and observation of their gait. Patient satisfaction and PRO scores were recorded preoperatively, at 3 months postoperatively, and annually thereafter. The PRO scores collected were mHHS, HOS-ADL, HOS-SSS, NAHS, and VAS. Preoperative strength and gait were compared to latest follow-up.

RESULTS: There were 25 patients that fit our criteria. Significant improvement in PRO scores were demonstrated for mHHS, HOS-ADL, HOS-SSS, NAHS, and VAS from 54.9-76.2, 50.2-80.6, 30.1-67.3, 51.9-82.4, and 7.1-2.7 respectively ($p<0.001$). There were 11 patients with appreciable weakness prior to surgery; 7 of these patients moved up at least one strength grade by final follow-up. There were 14 patients who had a Trendelenburg gait preoperatively, 12 of them had a normal gait at latest follow-up (p-<0.001). Average patient satisfaction was 7.5. There were no revision surgeries, and no complications noted.

CONCLUSION: PUSTA lesions can be treated successfully with endoscopic trans-tendinous repair preserving the intact attachment of superficial fibers of the gluteus medius. We recommend this treatment for partial undersurface tears recalcitrant to nonoperative treatment.

Treatment of Failed Constrained Liners in Revision Total Hip Arthroplasty with Dual Mobility Components

Abstract ID: Poster 021

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BACKGROUND: Re-recurrent instability is a challenging complication after revision total hip arthroplasty (THA) for instability. Salvage options to enhance stability in multiply operated upon, high-risk patients, including abductor procedures and constrained liners, have widely variable success rates and their own inherent disadvantages. We sought to analyze the outcomes of converting failed constrained liners to dual mobility components in recurrently dislocating THAs.

METHODS: Fourteen patients with a failed constrained liner secondary to recurrent dislocation that were revised to dual mobility components from 2011 – 2014 were retrospectively reviewed. 10 patients (71%) underwent dual mobility conversion at time of cup revision while four patients (29%) underwent modular exchange. Minimum follow-up was 2 years with a mean of 3 years. Mean age was 66 years. Mean number of prior hip surgeries was 5 and seven patients (50%) had failed more than one constrained liner secondary to instability.

RESULTS: Harris Hip Scores (HHS) improved from 60 to 85 postoperatively ($p = 0.001$). Four patients (29%) experienced a re-dislocation. Two (14%) of these patients were closed reduced and treated nonoperatively; one (7%) patient experienced an intra-prosthetic dislocation, a rare complication of dual mobility constructs, requiring modular exchange; the final patient (7%) underwent resection arthroplasty. Overall, one patient (7%) did not retain a dual mobility construct at final follow-up. There was no significant difference in number of prior surgeries, surgical approach, modular exchange vs. acetabular revision, or type or number of previous constrained liners in re-dislocation rates.

CONCLUSION: Conversion to a dual mobility construct is a reasonable salvage option in high risk, multiply operated upon patients with multiple failed constrained liners undergoing revision THA for recurrent instability. There was a 30% re-dislocation and 15% re-revision rate for re-dislocation at 2 years in this high risk cohort.

SUMMARY: Dual mobility constructs are a reasonable salvage option in high risk, multiply-operated upon patients that have failed constrained liners secondary to recurrent instability in revision THA.

Accuracy of Hip Aspirations Performed on Antibiotic Cement Spacers to Diagnose Persistent Infection

Abstract ID: Poster 022

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INTRODUCTION: Accurate diagnosis of infection in the interim period of a two-stage hip revision (i.e., antibiotic-loaded cement spacer implanted) is paramount and requires fluoroscopy-guided aspirations. Approximately 30% are “dry taps”, requiring saline-lavage and re-aspiration. Current diagnostic thresholds were designed for the first-stage revision, not the interim period. This study’s purpose was to (1) test whether saline-lavage influences diagnostic validity of aspirations, (2) assess diagnostic accuracy of preoperative aspirations performed in the interim stage, (3) determine optimal thresholds for diagnostic parameters of preoperative aspirations on hips with antibiotic-loaded cement spacers.

METHODS: Patients with antibiotic-loaded cement spacers inserted between 2012- 2015 (n=165) were reviewed. N=89 were aspirated and included (n=68 non-lavage and n=21 saline-lavage aspirations). Perioperative data was collected from electronic records. Hips were infected based on serology, histology, and intraoperative findings following MSIS criteria. Diagnostic parameters were calculated using MSIS criteria thresholds (e.g., white blood cell [WBC]>3,000 cells/µL, polymorphonuclear leukocyte [PMN]%>80%) for the non-lavage aspirations. Optimal thresholds were calculated for synovial WBC count and PMN% with a ROC curve.

RESULTS: In the saline lavage group (n=21), when comparing the infected versus non-infected hips, no significant differences in WBC count (782 cells/µL vs. 307 cells/µL, p=0.16) or PMN% (67% vs. 58%, p=0.31) were observed. In the non-lavage group (n=68), however, there were significant differences in the WBC count (6,994 cells/µL vs. 2,243 cells/µL, p=0.02) and PMN% (82% vs. 45%, p<0.001) between the infected and non-infected hips, respectively. Based on these results, the saline lavage aspirations were not included in any further analyses. Sensitivity, specificity, and accuracy of the WBC count was 44%, 85%, and 75%, respectively, and for the PMN% was 75%, 77%, and 76%, respectively. Calculated optimal thresholds for synovial WBC count and PMN% were 1,166 cells/µL and 67%, respectively. This newly established WBC count threshold (1,166 cells/µL) had a significantly higher sensitivity (75% vs. 44%, p=0.025) but lower specificity (77% vs. 85%, p=0.045) when compared to the MSIS threshold, respectively. There were no significant differences in terms of sensitivity and specificity between the newly established PMN threshold (67%) and MSIS threshold (80%) (p=0.157 for both).

CONCLUSION: WBC count and PMN% results from saline-lavage aspirations on antibiotic-loaded cement spacers are not reliable for treatment decisions. This study supports that optimal

thresholds for diagnosing infection in the interim period of a two-stage hip revision should be lower than current MSIS criteria suggest.

Body Exhaust Suit Iatrogenic Contamination in Total Joint Arthroplasties

Abstract ID: Poster 023

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INTRODUCTION: Periprosthetic Joint Infections (PJIs) are devastating complications. Multiple interventions, including body exhaust suits (BES), are utilized to try and decrease iatrogenic contamination and infection. However, modern BESs increase PJIs in multiple joint registries. We utilized surgical gown bacterial cultures from the forearms, chest, axillae, and facemask comparing traditional surgical attire (TSA), BES, and body exhaust suits with delayed ventilation (BES-DV) to identify areas of iatrogenic contamination.

METHODS: A single surgeon utilized TSA, BES, and BES-DV, which is fan initiation after gowning. Cultures were obtained from the bilateral forearms, axillae, and the sternum in all groups with the inclusion of the helmet in the BES and BES–DV groups. Cultures identified Beta-hemolytic streptococcus (strep) and Staphylococcus (S.) speciation including coagulase negative Staphylococcus (CNS). Remaining bacterial growth was morphologically identified.

RESULTS: The TSA had 33 patients with 99 samples, BES had 59 patients with 236 samples, and BES-DV had 18 patients with 72 samples. Positive patient cultures in the TSA, BES, and BES-DV groups were 18%, 24%, and 10% and positive swabs were 7%, 7%, and 2%, respectively. CNS was the primary contaminant present in 75%, 81%, and 67% of the positive cultures for the TSA, BES, and BES-DV groups, respectively. The BES and BES-DV groups had 19% and 3% of shield swabs positive, respectively. The TSA, BES, and BES-DV had 15%, 5%, and 0% of positive forearm swabs, respectively.

CONCLUSION: BES contamination was primarily at the surgical hood while this and total contamination was decreased in the BES-DV group. The TSA had the most forearm contamination. Thus, the surgical hood in the BES is likely a significant cause for increased PJIs with BES, which is reduced in the BES-DV group. The forearm does not appear to be a clinically significant area of contamination in BES.

Level of Evidence: I

Utility of Synovial Fluid, Whole Blood, and Serum Metal Ion Levels in Failed Metal-on-Metal Total Hip Arthroplasty

Abstract ID: Poster 024

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BACKGROUND: Adverse reactions to metal debris have resulted in high rates of implant failure in patients with metal-on-metal (MoM) total hip arthroplasty (THA) as well as in the setting of taper corrosion. Currently, the concentration of blood metal ions, cobalt (Co), and chromium (Cr) are used to stratify patients at risk for failure; however, the levels often do not correlate with the soft-tissue reaction at the time of revision. The purpose of this investigation was to evaluate the concentrations of Co and Cr ion levels in the serum, whole blood, and synovial fluid in patients with a failed THA due to a presumed metal reaction compared to patients without.

METHODS: Following local IRB approval, synovial, blood, and serum samples were prospectively captured from patients at the time of revision THA with a presumed metal reaction (n=23). This cohort consisted of 10 females and 13 males, with a mean age and body mass index (BMI) of 65 years and 28.6 kg/m^2. Prior to revision patients underwent cross-sectional imaging to evaluate for pseudotumor formation.

The same samples were collected from patients undergoing aseptic revision without a perceived metal reaction (n=18). This cohort consisted of 9 females and 9 males, with a mean age and BMI of 63 years and 32.1 kg/m^2. RESULTS: At the time of revision THA, the mean synovial, blood, and serums Co and Cr levels were significantly elevated in patients with a metal reaction. In the metal reaction cohort, 16 patients had evidence of a soft-tissue fluid collection preoperatively based on cross sectional imaging, with a mean volume of 250 cm^3 (range 5-1,408 cm^3). In comparing the mean concentration of serum, whole blood, and synovial fluid metal ion levels in patients who developed a soft-tissue fluid collection compared to those who did not, only the synovial fluid cobalt level was found to be significantly different (1,960 ng/ml vs. 191 ng/ml, P=0.03). Patients with synovial Co levels greater than 10 ng/ml were at significantly increased risk for pseudotumor formation (LR 11.9, P<0.0001).

CONCLUSION: Co and Cr levels are significantly elevated in the blood, serum, and synovial fluid of patients with a failed THA in the setting of a metal reaction. The results of this study demonstrate that a synovial fluid Co level over 10 ng/ml was significantly associated with pseudotumor formation. This could potential be used to identify patients at risk for soft-tissue destruction with an otherwise asymptomatic MoM THA.

KNEE

Not a “Benign” Disease: High Rate of Local Recurrence and Amputation Following Total Knee Arthroplasty in the Setting of Synovial Chondromatosis

Abstract ID: Poster 025

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INTRODUCTION: Synovial chondromatosis is an uncommon, monoarticular arthropathy due to synovial metaplasia. This can lead to joint destruction and stiffness. There is a paucity of data specifically examining the outcome of total knee arthroplasty (TKA) in the setting of synovial chondromatosis of the knee, one of the most common locations for the disease. The purpose of this study is to investigate the oncologic and functional outcome of patients undergoing TKA in the setting of synovial chondromatosis with a focus on (1) disease specific survival, (2) rates of amputation and reoperation, and (3) patient function.

METHOD: Twenty patients were identified with histologically confirmed synovial chondromatosis of the knee undergoing TKA between 1989 and 2013. All patients were followed for at least two years with mean follow-up of 7 years. There were 12 males and 8 females, with a mean age of 63 years and mean body mass index of 30.7 kg/m2. Prior to TKA, 16 patients had at least 1 surgical procedure (mean 3) to treat the synovial chondromatosis. 17 patients had “active” disease, defined by the presence of proliferative synovial tissue and intraarticular loose bodies. These patients underwent a formal synovectomy at the time of TKA.

RESULTS: The 5-year disease free-survival was 78%. Recurrence occurred in 4 patients at mean 1 year following TKA. Recurrence was treated with synovectomy and revision TKA (n=2), observation (n=1), and transfemoral amputation (n=1) due to malignant degeneration to chondrosarcoma. One of the patients who underwent a revision TKA subsequently underwent a transfemoral amputation 4 months following revision for another recurrence. The overall rate of amputation was 10%. Prior to surgery, the mean Knee Society Score (KSS) and Functional (KSSf) assessment were 35 and 42. There was a significant improvement in both the KSS (mean 74, $P<0.0001$) and KSSf (mean 67, $P=0.001$) following TKA.

CONCLUSION: The results of this study indicate TKA in the setting of synovial chondromatosis improves patient function; however, there is a high rate of local recurrence and complications. Patients with a history of synovial chondromatosis should be informed about the potential for disease recurrence, limited motion, and amputation after TKA.

Periprosthetic Fractures of the Distal Femur: Is ORIF or Distal Femoral Replacement Superior?

Abstract ID: Poster 026

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INTRODUCTION: Periprosthetic distal femur fractures above a total knee arthroplasty (TKA) are becoming increasingly common. The available literature is limited with regards to the optimal surgical management strategy for these patients. The purpose of this study is to compare open reduction and internal fixation (ORIF) to distal femoral replacement (DFR) for treatment of these injuries.

METHODS: Following IRB approval, we identified 76 patients with a Type 2 periprosthetic distal femur fracture (displaced, components well-fixed), 53 of whom were treated with ORIF and 23 with DFR. Patients were evaluated clinically using the Knee Society Score (KSS) and radiographically for evidence of fracture union or implant loosening. All outcomes comparisons were adjusted for age, sex, and Charlson comorbidity index.

RESULTS: Demographics between the two groups were similar; however, patients treated with DFR had a higher mean Charlson comorbidity index (5.2 vs. 3.8; p =0.006). The mean postoperative KSSs were 85.0 and 83.6 (p=0.819), and the mean functional scores were 41.9 and 52.3 (p=0.339) for the DFR and ORIF groups, respectively. 45 ORIF and 20 DFR patients had 2-year follow-up. Of these, 5 ORIF patients (11.1%) and 2 DFR patients (10.0%) underwent a reoperation (p=0.587; mean of 1.7 reoperations for ORIF patients and mean of 1.0 for DFR). 6 ORIF patients (13.3%) and 6 DFR patients (27.3%) died within two years (p=0.381).

CONCLUSION: Distal femoral replacement and ORIF showed similar outcomes with regards to KSS, revision rate, and mortality rate following adjustment for demographic and comorbidity characteristics. However, the available sample size may have limited the ability to demonstrate any true differences in outcomes. Given the strikingly high mortality and the substantial risk of reoperation, additional studies are needed to determine optimal treatment options for patients with periprosthetic fractures of the distal femur.

Impact of Operative Time on Adverse Events Following Primary Total Joint Arthroplasty

Abstract ID: Poster 027

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INTRODUCTION: Little is known regarding the impact of operative time on adverse events following total joint arthroplasty (TJA). The purpose of this study is to test whether increased operative time is independently associated with the occurrence of adverse events following primary total hip and knee arthroplasty.

METHODS: Patients undergoing elective primary total hip or knee arthroplasty were identified in the American College of Surgeons National Surgical Quality Improvement Program. Operative time was tested for association with perioperative outcomes using multivariate regression. All regressions were adjusted for differences in baseline characteristics.

RESULTS: 165,474 patients met inclusion criteria. The mean (+/- standard deviation) operative time was 91.9+/-32.5 minutes (92.3 minutes for THA and 91.6 minutes for TKA). Following adjustment for all demographic, comorbidity, and procedural characteristics, each increase in operative time by 15 minutes increased the risk for anemia requiring transfusion by 9% (95% confidence interval [CI]=8-10%, p<0.001), wound dehiscence by 13% (95% CI=8-19%, p<0.001), renal insufficiency by 9% (95% CI=3-14%, p<0.001), sepsis by 10% (95% CI=6-14%, p<0.001), surgical site infection by 9% (95% CI=7-12%, p<0.001), and urinary tract infection by 4% (95% CI=2-6%, p<0.001). Similarly, each increase in operative time of 15 minutes increased the risk for hospital readmission by 5% (95% CI=4-6%, p<0.001) and for extended hospital length of stay by 9% (95% CI=8-10%, p<0.001).

CONCLUSIONS: The present study suggests that greater operative time increases the risk for multiple complications following TJA. These data suggest that surgeons should consider steps to minimize operative time without compromising the technical components of the procedure.

The Treatment of Adult Osteochondritis Dissecans with Autologous Cartilage Implantation: A Systematic Review

Abstract ID: Poster 028

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PURPOSE: Many studies have investigated the efficacy of autologous cartilage implantation (ACI) for the treatment of osteochondritis dissecans (OCD), but a systematic review of all the available evidence is lacking. The purpose of this review was to summarize the effectiveness of ACI for the treatment of adult OCD, based on clinical and radiographic findings.

METHODS: A search of MEDLINE, Scopus, and Cochrane Library was performed to identify clinical studies (levels I-IV) that reported outcomes after ACI treatment for OCD in the adult knee. Our inclusion criteria included the following: (1) published between January 2000 and August 2015, (2) stable and unstable OCD lesions of the human knee, (3) operative study, (4) subjects ≥18 years old or skeletally mature, (5) quality measures of clinical outcomes, (6) written in English. Exclusion criteria: (1) non-clinical studies, (2) non-human studies, (3) review papers, (4) Studies without OCD stratified data.

RESULTS: A total of 10 papers with 211 patients, mean age of 26.7 years (range, 18-49 years), were indentified for inclusion. There were a total of 227 lesions with an average size of 4.1 cm^2 (range, 1.2-9.4 cm^2). The average follow-up was 61.7 months (range, 6.5-120 months). Patients were evaluated with several outcome measures, including International Knee Documentation Committee Form (62%), EQ Visual Analogue Scale (44%), Tegner Activity Scale (48%), Lysholm Knee Questionnaire (33%), and Cincinnati Rating System (11%). Statistically significant improvement in clinical outcomes was reported in all studies. Chi-square analysis of combined data was performed. There were 27 complications (12%) reported, including 17 failures (7%).

DISCUSSION: Significant improvement in clinical outcome measures demonstrates the clinical efficacy of ACI for the treatment of OCD in adult patients. Many of the studies noted better outcomes with males, sport active patients, smaller lesion sizes, and younger age at time of surgery. Further investigation is needed to better understand ACI as it compares to other treatment methods used for cartilage lesions, as well as to evaluate the long-term effects of ACI and its potential to reduce future degeneration of the joint.

Impact of Anterior Cruciate Ligament Status on Early Satisfaction and Clinical Outcomes Following Total Knee Arthroplasty

Abstract ID: Poster 029

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INTRODUCTION: Total knee arthroplasty (TKA) is a successful treatment for osteoarthritis (OA); however, many patients experience dissatisfaction. One hypothesis for dissatisfaction is the distortion of native knee kinematics following sacrifice of the anterior cruciate ligament (ACL). The purpose of this study was to determine the impact of ACL status at the time of surgery in patients undergoing TKA.

METHODS: A consecutive series of patients undergoing TKA had intraoperative evaluation of the ACL as follows: (1) intact, (2) intact and weak, or (3) deficient. Perioperative data were collected by 2 blinded, independent observers. Outcomes were patient satisfaction and Knee Society Score for Pain (KSS) and Function (KSF). Patient reported satisfaction was recorded as: very satisfied (1), satisfied (2), satisfied with complaints (3), and unsatisfied (4). Outcomes were also correlated with Kellgren-Lawrence grade (K-L) as determined on preoperative radiographs. Statistical analysis was performed with a multivariate regression analysis.

RESULTS: 163 patients with mean clinical follow-up of 6.1 ±1.3 months were included. ACL status was associated with sex, BMI, and K-L grade ($p<0.05$ for each). Eighty knees had intact ACLs (49.1%), 63 were intact-weak (38.7%), and 20 were deficient (12.3%). Patients with an absent ACL were significantly more likely to have a higher BMI ($p=0.043$), higher preoperative K-L grade ($p<0.001$). Controlling for sex and BMI: patients with a deficient ACL had significantly lower preoperative KSS and KSF scores compared to all other groups (KSS $p=0.049$, KSF $p=0.001$), and had significantly greater magnitudes of improvement in KSS postoperatively ($p=0.001$). Mean satisfaction for all groups corresponded to satisfied ($p=0.651$), with no differences in patient satisfaction based on ACL status. Analysis controlling for sex, BMI, and K-L grade showed no statistically significance outcome differences between patients.

CONCLUSION: At surgery, 12.3% of patients have an absent ACL. Patients with ACL deficiency are more likely to have worse preoperative KSS scores and experience more relief, suggesting that those with abnormal knee kinematics prior to TKA may experience more subjective improvement from arthroplasty.

Athletes and Non-Athletes Exhibit Differing Patterns of Symptomatic Knee Cartilage Defect Size and Severity at Time of Surgery

Abstract ID: Poster 030

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BACKGROUND: Knee cartilage defects cause significant pain and limitation in patients. Due to differing demographics and functional demands on the knee joint, athletes vs non-athletes may have unique patterns of cartilage lesions. The purposes of this study are: (1) to describe differences between athletes and non-athletes in lesion size and grade at time of surgery and (2) to determine the relationship between cartilage lesion size and severity and concomitant knee injuries, smoking status, BMI, and patient age among athletes and non-athletes.

METHODS: A total of 987 patients (476 athletes, 511 non-athletes) who underwent arthroscopic knee surgery at a single institution between 2006 and 2013 were included. Lesion size, grade (partial versus full thickness), and number of lesions were documented by direct visualization. Clinical data including activity level and concomitant injuries were obtained via medical record review. Differences in lesion size, severity, number of lesions, and time between symptom on onset and surgery were compared between athletes and non-athletes with chi-square and student's t-tests. Multivariate logistic regression was used to assess activity level, concomitant injury, and demographic factors (smoking status, age, and BMI) as predictors of lesion size and grade.

RESULTS: Athletes were younger (31.2 years SD 13.0 vs. 41.1 years SD 12.5, $p<0.001$) and had significantly shorter time between symptom onset and surgery (median 102 days IQR 39-257) compared to non-athletes (median 177 days IQR 84-455; $p<0.001$). Athletes tended to have smaller defects (3.1 cm square SD 2.5 vs. 4.3 cm square SD 4.1, $p=0.02$) and were less likely to have a full thickness defect (32% vs. 38% non-athletes, $p=0.049$). Athletes were more likely to present with a concomitant ACL injury (32% vs. 11%, $p<0.001$) and had a higher rate of reparable meniscus injury (18.3% vs. 5.4%, $p<0.001$). Increased BMI was significantly associated with increased likelihood of a full-thickness defect among athletes (OR 1.06 CI 1.00-1.12 per 1 point increase in BMI; $p=0.02$) but not among non-athletes (OR 0.99 CI 0.94-1.06, $p=0.81$). Increased age was associated with increased risk of full thickness defect regardless of activity level (OR 1.02 CI 1.00, 1.03 per year, $p=0.01$).

CONCLUSION: Athletes who undergo surgery for cartilage defects tended to do so sooner after symptom onset than non-athletes, have smaller defects, and were less likely to have a full thickness defect despite having higher rates of concomitant ACL injury. Additionally, athletes with higher BMI are at increased risk of having a full thickness defect.

Bacterial Deoxyribonucleic Acid (DNA) is Often Present in Ruptured Graft Tissue at Time of Revision Anterior Cruciate Ligament (ACL) Reconstruction

Abstract ID: Poster 031

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INTRODUCTION: Failure rates following primary anterior cruciate ligament (ACL) reconstruction range from 1-27% and has been attributed to risk factors including graft selection, surgical technique, as well as patient factors. Colonization of ACL reconstruction graft with low virulence bacteria could cause graft tissue attenuation without overt clinical symptoms and predispose patients to ACL graft failure. Polymerase chain reaction (PCR) is a highly sensitive method for detecting bacteria present in very low concentrations and detecting species that cannot be reliably cultured in a clinical laboratory. We hypothesize that bacterial DNA will be detectable via PCR in torn graft tissue at time of revision ACL reconstruction and will be present at higher rates than in primary ACL reconstruction graft tissue.

METHODS: A total of 31 consecutive revision ACL reconstruction cases (mean age 28 SD 5.1 years) and 5 primary ACL reconstruction controls (all hamstring autograft; mean age 27 SD 4.6 years) from one center were included. All revision patients were first time revisions and had no clinical signs of infection. Among revision cases, autograft was used in 22/31 (71%) and allograft in 9/31 (29%) at the time of index operation. Mean time to failure was 15.8 months (range 6 months-7 years). A graft tissue sample was obtained with sterile instruments (not used earlier in the procedure) from the tibial tunnel in revision cases and from excess tibial sided graft after passage and graft fixation in primary cases. A PCR analysis was performed with a universal bacterial probe on all tissue samples.

RESULTS: Bacterial DNA was detectable in torn graft tissue in most revision ACL cases 27/31 (87.0%) and less commonly 1/5 (20%) in primary ACL autograft controls (p=0.002, Chi-square test). Median bacterial DNA concentration in torn grafts at time of revision ACL was low at 17.5 ng/ml (range 0-101) with no difference found between revision patients with allograft (median 18.6 ng/ml range 0-45) vs. autograft (median 17.1 ng/ml range 0-105) used at time of primary ACL reconstruction (p=0.56, Wilcoxon rank sum).

CONCLUSIONS: Bacteria is often present in torn graft tissue at time of revision ACL reconstruction and at much higher rates than seen from similar graft tissue samples from primary ACL reconstructions. These findings suggest likely bacterial colonization of many failed ACL grafts though the causal relationship between graft colonization and failure remains unclear.

Partial Anterior Cruciate Ligament Tears: The Role of Single-Bundle Reconstruction

Abstract ID: Poster 032

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INTRODUCTION: Recent characterization of distinct anteromedial and posterolateral bundles comprising the anterior cruciate ligament (ACL) has redefined how surgeons approach reconstruction of single-bundle tears. Single-bundle tears have been reported to account for 10-38% of ACL tear injuries, and have traditionally been repaired by double-bundle reconstruction, where both bundles are removed and replaced with a graft. Many now advocate for selectively reconstructing the torn bundle while preserving and augmenting the remnant bundle. In this study, we have examined consecutive partial ACL tears and reported early clinical outcomes of selective single-bundle ACL reconstruction and/or augmentation.

METHODS: Interviews were conducted via telephone after an average postoperative period of 31 months (range: 23-53 months); IKDC, Lysholm, and Tegner scores were obtained. Eleven patients whose physical examination and intraoperative evaluation indicated a stable remnant bundle and six patients whose evaluation indicated an unstable remnant bundle were interviewed. Four patients who had single-bundle augmentation of a previous double-bundle reconstruction were also interviewed.

RESULTS: Patients who underwent single-bundle reconstruction with a stable remnant bundle reported average IKDC and Lysholm scores of 80.6 and 92.2, respectively. Those with an unstable remnant bundle reported average IKDC and Lysholm scores of 68.3 and 86.2, respectively. Patients who had single-bundle augmentation of previous double-bundle reconstructions reported average IKDC and Lysholm scores of 66.8 and 77.8, respectively. One-way analysis of variance revealed no significant difference in mean IKDC ($p=0.08$) or Lysholm ($p=0.19$) scores. Average pre-injury/post-recovery Tegner scores were 7.7/7.5 for patients with a preoperatively stable remnant bundle; scores for patients with an unstable remnant bundle were 7/6.5. Patients with a previous double-bundle reconstruction reported average Tegner scores of 8.25/6.25. One-way analysis of variance revealed no significant difference in mean Tegner score change ($p=0.29$) between the groups.

CONCLUSIONS: Sample size limited our ability to show statistical differences between patient groups. However, previous studies corroborate our reported clinical outcomes. In our experience, single-bundle reconstructions recover as well as, and in some cases earlier than, routine double-bundle reconstructions for partial ACL tears. Preserving the remnant bundle provides greater stability in the immediate postoperative period, allowing for more rapid recovery and return to pre-injury activities. The resultant larger overall size of the reconstructed ligament also leads to lower failure rate. Based on the data collected and observations made, we believe that preservation of a stable remnant ACL bundle while reconstructing the torn bundle is technically feasible, reproducible, and does not compromise clinical outcomes.

Medial Patellofemoral Ligament Reconstruction - Semitendinosus Allograft vs. Peroneus Longus Allograft

Abstract ID: Poster 033

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Patellar instability is a common and debilitating knee condition. Medial patellofemoral ligament (MPFL) reconstruction is frequently utilized to restore stability in cases of recurrent patellar dislocation. Semitendinosus and gracilis tendon allografts have been successfully used for these reconstructions. Unfortunately, these grafts are not always readily available so alternative allograft sources should be explored. The objective of this study was to compare the outcomes of semitendinosus and peroneus longus allografts for reconstruction of the MPFL.

The study was approved by the institution's IRB. A retrospective study was conducted on 70 patients that underwent MPFL reconstructions using allografts. Of these 70 patients, 50 received semitendinosus allografts, while 20 patients received peroneus longus allografts. Patient demographics, postoperative range of motion, return to activity, and complications following surgery were recorded and compared between the two groups.

The group included 40 female and 30 male patients, with a mean age of 23.1 years (range: 14 to 46 years). The mean follow-up was 7.7 months. No significant differences were noted between the two groups in regards to time to regain full range of motion (peroneus longus: 3.6 months, semitendinosus: 4.6 months, $p>0.05$) or return to full activity (peroneus longus: 7.0 months, semitendinosus: 6.5 months, $p>0.05$). Two patients (both semitendinosus allografts) had recurrent instability episodes at 24 months and 30 months. One patient in the semitendinosus allograft group underwent manipulation under anesthesia for stiffness.

There were no significant differences between peroneus longus and semitendinosus allografts for reconstruction of the MPFL. Peroneal longus allograft is a viable allograft option for MPFL Reconstruction.

Does Medial Pivot Kinematics Correlate with Functional Outcomes After Total Knee Arthroplasty?

Abstract ID: Poster 034

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INTRODUCTION: Some propose optimal kinematics in total knee arthroplasty (TKA) is a medial pivot pattern and some implants are designed to facilitate this pattern. The purpose of this study was to determine whether intraoperative medial pivot kinematic patterns are correlated with improved functional outcomes following primary TKA.

METHODS: A retrospective review was performed of consecutive primary TKAs by two surgeons with a modern implant design. Sensor-embedded trials determined kinematic patterns intraoperatively. Contact points of medial and lateral condyles were recorded for each patient at 0^0 and 90^0 of flexion. The contact points created vector intersections and centers of rotation, designated medial-pivot or non-medial pivot pattern based on accepted criteria. The modern Knee Society Score, EQ5D Health Status Index, and UCLA Activity Level Score were measured preoperatively and at minimum one-year follow-up.

RESULTS: 150 consecutive TKAs met inclusion criteria; nine patients were lost to follow-up. 75% of patients were female. Mean age and BMI were 63.6 years and 33.8, respectively. A medial pivot kinematic pattern from 0° to full flexion comprised 31% (n=44) of TKAs. Sex, age, height, weight, and BMI were unrelated to kinematic pattern with numbers available ($p \geq 0.133$). Improvement in Knee Society, EQ5D, and UCLA scores, as well as those outcomes scores at latest follow-up did not differ between medial and non-medial pivot patterns ($p \geq 0.219$) with the numbers available. Walking pain alone improved greatest in those TKAs with a medial pivot pattern ($p = 0.010$).

DISCUSSION: Our results suggest that a medial pivot pattern from terminal extension to full flexion may not be a substantial governor of clinical success based on intraoperative kinematics and modern outcome measures. Further research is warranted to determine if a particular intraoperative or in vivo kinematic pattern promotes optimal clinical outcomes after TKA.

Promotion of MIS and CAOS in TKA by Members of AAHKS: What Has Changed in a Decade?

Abstract ID: Poster 035

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INTRODUCTION: A decade ago minimally invasive surgery (MIS) and computer-assisted orthopedic surgery (CAOS) in total knee arthroplasty (TKA) were 'hot button' topics, but had not yet reached widespread acceptance. The purpose of this study was to answer the question, 'How has the level of internet promotion of MIS and CAOS in TKA by members of AAHKS changed over the last decade?'

METHODS: An internet search was performed to identify surgeon-specific websites for each active AAHKS member using the members' full name and a previously published set of criteria. Each website was evaluated utilizing a previously published questionnaire to systematically identify claims made regarding MIS TKA specific benefits, risks, as well as presence/absence of supporting data. This information was then compared to previously published data obtained in 2006.

RESULTS: 1,631 active AAHKS members were found to have 1,807 qualified websites, an increase of 148% from the previous study. Reference to MIS TKA was identified on 21.5% (389/1807) of these websites, compared to 12.7% (92/727) a decade ago ($p<0.001$). Conversely, MIS-specific TKA risks were presented by only 5.7% (22/389) of websites compared to 25% (23/92) in 2006. Promotion of CAOS has doubled from 5.6% to 11.5% ($p<0.001$) over the same timeframe.

CONCLUSIONS: The internet footprint of AAHKS members has grown dramatically in the last decade. While promotion of MIS and CAOS in TKA has risen significantly, reference to MIS-specific risks has dropped nearly 5-fold. This potentially demonstrates more mainstream acceptance of these options as safe and reliable, although reference to supporting peer-reviewed literature remains rare. While AAHKS policy does not regulate member marketing, it is the responsibility of all orthopedic surgeons to disseminate accurate, validated information concerning the procedures we perform.

High Incidence of Stress Shielding and Radiolucent Lines with a Novel Total Knee System

Abstract ID: Poster 036

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INTRODUCTION: Stress shielding and radiolucent lines have frequently been identified on postoperative radiographs following joint arthroplasty, but the implications of these findings remain poorly understood. A relationship between stress shielding and bone resorption leading to resultant aseptic loosening and implant failure has been identified. The purpose of this study was to determine the incidence of radiographic stress shielding and radiolucent lines in the tibia and femur during the early postoperative period following primary total knee arthroplasty (TKA) with a novel implant that recently became available in 2013.

METHODS: Between February 2013 and February 2015, 164 patients underwent a TKA with a novel total knee implant by a single experienced, fellowship-trained adult reconstruction surgeon at an academic medical center. A minimum of 2 months of radiographic follow-up was required, leaving 136 patients for analysis. To assess for radiographic changes, the most recent postoperative radiographs (anterior-posterior [AP], lateral, Merchant views) were compared to the immediate postoperative radiographs. These images were independently evaluated by the operative surgeon and two orthopedic research fellows using the updated Knee Society Radiographic Evaluation System. At each implant zone, the radiographs were assessed for the presence of stress shielding, radiolucent lines, or implant loosening. The incidence rate of these radiographic findings was determined at all implant zones for each evaluator.

RESULTS: The mean length of postoperative radiographic follow-up was 8 months (range 2-34). For all evaluators, stress shielding was most frequently identified at the same three zones with the highest incidence at tibial AP zone 1 (medial baseplate). The incidence rates observed at this zone were 39.0%-48.5%. Stress shielding was also frequently observed on the femoral lateral zone 3A (anterior chamfer) with incidence rates of 15.4%-34.6%, and zone 3 (central peg region) with incidence rates of 11.8%-26.5%. Similarly, radiolucent lines were identified most frequently at tibial AP zone 1 by all evaluators, with incidence rates of 10.3%-13.2%. Two tibial components demonstrated aseptic loosening which was identified by all evaluators (1.5%).

CONCLUSION: In this series of patients who underwent TKA with a novel implant that was released in 2013, the mean incidence rate of stress shielding at tibial AP zone 1 among all evaluators was 43.1% and the mean incidence rate of radiolucent lines observed at this zone was 12.0%. Close follow-up of these patients is warranted to monitor for continued progression and elucidate the relevant clinical correlation of these changes.

Antibiotic-Impregnated Calcium Sulfate Beads Fail to Improve Outcome of Irrigation and Debridement in Acute Periprosthetic Joint Infection

Abstract ID: Poster 037

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Dr. Culp was the recipient of a Mid-America Orthopaedic Association poster award.

BACKGROUND: One proposed strategy to increase the success of irrigation and debridement with implant retention for the treatment of acute periprosthetic joint infection (PJI) is the use of dissolvable antibiotic impregnated calcium sulfate beads to provide a local depot of antibiotics. The purpose of this study was to evaluate the outcome of such an approach.

METHODS: Thirty-two patients with acute hematogenous (18 patients; 1 bilateral) or acute postoperative (14 patients) PJIs who underwent irrigation and debridement with implant retention and addition of antibiotic-impregnated calcium sulfate beads were retrospectively reviewed. PJI followed 6 total hips and 26 total knees. The most common infecting organisms were methicillin-sensitive Staphylococcus aureus (13/33) and beta-hemolytic Streptococcus (7/33). The primary outcome parameter was recurrence of infection according to MSIS criteria. Patients were followed for a minimum of 3 months or until failure.

RESULTS: At a mean of 12.7 months (range, 3 to 30 months), 15 of the 33 patients failed (45%). Acute hematogenous and acute postoperative PJI had similar failure rates at 47% and 50%, respectively (p=0.88). Seven failures required a two-stage exchange, while 8 patients were treated with chronic antibiotic suppression, being unwilling or unable to undergo further surgical intervention.

CONCLUSION: The addition of antibiotic-impregnated calcium sulfate beads does not appear to improve outcomes of irrigation and debridement with implant retention in the setting of acute hematogenous or acute postoperative PJI. Given the short follow-up in this report, this represents a best case scenario and the overall failure rate may be higher with further follow-up.

Use of Polyester Mesh and 2-octyl Cyanoacrylate Adhesive for Skin Closure of Primary Knee Arthroplasty

Abstract ID: Poster 038

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INTRODUCTION: Wound closure in primary knee arthroplasty has attracted increasing attention due to growing consideration of patient satisfaction measures related to wound care and cosmesis. We report a closure method without external staples or sutures that uses a topical self-adhering, pressure sensitive polyester mesh combined with 2-octyl cyanoacrylate adhesive for the final skin closure. While the plastic surgery literature has explored the use of this closure method in primary, high-tension wounds, there has been no documentation of its use in the orthopedic surgery literature. We present a series of primary knee arthroplasties closed via this technique.

METHODS: Over a two and a half year period, 321 consecutive primary total and 39 partial knee arthroplasties by one surgeon at one institution were reviewed. All primary arthroplasties were closed with a standardized technique. Closure was attained via a standard 0-diameter braided absorbable capsular closure, 2-0 diameter absorbable monofilament dermal closure, and a 3-0 diameter absorbable monofilament subcuticular closure. The final skin closure was 2-octyl cyanoacrylate adhesive and polyester mesh. Patients were instructed to apply petroleum jelly to the mesh and remove the dressing at 10-14 days following surgery. Patients were instructed to follow up at 6 weeks and 1 year postoperatively. We reviewed the incidence of wound complications in all patients at short-term (3 to 6 week) and long-term (12 to 18 month) follow-up intervals, in addition to patient demographic information.

RESULTS: In our cohort of 321 primary knee arthroplasties, there were no dehiscences, no wound complications requiring operative irrigation and debridement, and no prosthetic joint infections. One patient sustained a reaction consistent with localized contact dermatitis thought to be related to the closure material that resolved by the six-week follow-up visit. This response was similar to previously reported localized skin reactions to 2-octyl cyanoacrylate adhesive. Two patients were treated with cephalexin, one for 2 small suture abscesses that resolved by 6 weeks, and another for peri-incisional cellulitis that also resolved by 6 weeks. The average body mass index of the cohort was 34.7 kg/m^2. 16.3% of patients had diabetes mellitus, with an average hemoglobin A1c of 6.5%. Patients were universally compliant with preoperative dressing self-care instructions.

CONCLUSION: 2-octyl Cyanoacrylate Adhesive (Dermabond™) and Polyester Mesh (Prineo™) can be successfully utilized in the setting of primary knee arthroplasty and provides a promising means of closure for high-tension knee arthroplasty wounds without external staples or sutures.

Short-Term Morbidity and Readmissions are Increased with Skilled Nursing Facility Discharge Following TJA

Abstract ID: Poster 039

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BACKGROUND: Medicare policy requires a minimum three-day hospital stay for patients discharging to SNF. We sought to determine short-term complication and readmission rates for SNF versus home discharge in a cohort of patients 65 and older who were discharged after postoperative day 3.

METHODS: Patients who underwent total hip or knee arthroplasty between 2012 and 2013 were identified in the National Surgical Quality Improvement Project (NSQIP) database. Patients younger than 65, and those over 65 who were discharged prior to postoperative day 3, and thus not SNF eligible by Medicare rule, were excluded from the analysis in order to create a Medicare and SNF eligible cohort. Patients were classified according to discharge disposition, categorically defined as home or SNF. Patient demographics and comorbidities as well as short-term complications were compared between cohorts.

RESULTS: Overall 34,610 Medicare and SNF eligible TJA patients were identified. 54.8% of patients discharged home. Patients who discharged to SNF compared with home were older, had higher rates comorbidities, and were more frequently ASA class 3 or 4. Patients discharging to SNF had a higher rate of any complication (7.9% v. 4.7%) and readmission (5.3% vs. 3.3%). Discharge to SNF (OR 1.9), ASA class 3 or 4 (OR 1.5), age >80 (OR 1.2), COPD (OR 1.4,), and dependent functional status (OR 1.5) were independent risk factors for a 30-day complications. These same variables were also significant predictors of 30-day readmission.

CONCLUSIONS: In a cohort of Medicare and SNF eligible patients, discharge to a SNF was the strongest predictor of 30-day complication following TJA. Additionally, SNF discharge was an independent predictor of readmission following TJA. Given these findings, concerted efforts from institutions and surgeons to promote discharge to home are warranted. More frequent short-term follow-up and surveillance of patients discharged to SNF's may be warranted.

Improved Outcomes in TKA with Utilization of a Bipolar Sealer in Addition to TEA?

Abstract ID: Poster 040

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BACKGROUND: The use of tranexamic acid (TEA) has been shown to significantly reduce the need for blood transfusions in elective primary total knee arthroplasty. In addition, electrocautery devices are routinely used for controlling blood loss during surgery. Bipolar sealers represent advancement in electrocautery technology that provides hemostatic sealing of soft tissue and bone during surgery. With recent emphasis on efforts to reduce healthcare costs and decrease risk to patients, the effectiveness of orthopedic devices in decreasing blood loss and transfusions while improving outcomes should be closely evaluated. There is limited literature reviewing the impact surgical bipolar sealer electrocautery instruments have had since TEA has become routinely administered in total joint arthroplasty.

METHODS: We performed a retrospective review of 143 consecutive patients who underwent primary total knee arthroplasty over a 4 month time period (December 2015-March 2016) at a single institution by two fellowship-trained arthroplasty surgeons with similar techniques. We compared the postoperative hemoglobin drop, range of motion, length of stay, and transfusion requirements of the bipolar sealer group (79 patients) versus the no bipolar sealer group (64 patients). Our standard protocol consisted of one surgeon using a bipolar sealer device to achieve hemostasis in all primary total knees and one surgeon using only standard electrocautery in all cases. All patients received standard IV dosing of TEA, 1000mg IV at incision, and the same dose repeated two hours later.

RESULTS: The average postoperative hematocrit change was 6.6 mg/dL in the no bipolar sealer group and 6.1 mg/dL in the bipolar sealer group. Average range of motion (95°, 91°) and length of stay (2.2 days, 2.1 days) were similar between the bipolar sealer and no bipolar sealer group, respectively. There were no significant differences in any of the outcome measures reviewed between the two groups. There were no transfusions required in the 143 patients reviewed.

CONCLUSION: The routine use of bipolar sealer during primary total knee arthroplasty demonstrated no significant difference in postoperative hematocrit change, range of motion, length of hospital stay, and blood transfusion rates. The addition of bipolar sealer devices in patients receiving TEA and undergoing primary total knee arthroplasty may not provide an advantage that would warrant the increased cost in these cases.

Outcomes and Effectiveness of Antibiotic Spacers for the Treatment of Infected Total Knee Arthroplasty

Abstract ID: Poster 041

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INTRODUCTION: A 2-stage revision surgical procedure is the gold standard in treating periprosthetic knee infections. The purpose of this study is to identify the effectiveness of both articulating and static spacers in controlling infection and to report the outcomes of a series of patients with infected TKA.

METHODS: 86 patients with either a static or articulating antibiotic spacer for infected TKA were analyzed. Average follow-up was 3.22 years (0.3 – 10.6 years). Patient specific covariates, causative organisms for the infection, type of spacer implanted, need for use of augments, and final operative outcomes were analyzed. A positive outcome was defined as minimal pain, and remaining infection-free until the time of the latest follow-up. Failure was defined as any situation where the patient underwent fusion, amputation, or was unable to clear the infection at last follow-up. Statistical comparisons were made using Student's t-test and chi-square analysis for proportions with a significance level of 0.05.

RESULTS: The study population included 31 males and 55 females. 54 patients received articulating spacers, while 32 patients received static spacers. 53 cases (62%) were able to clear the infection and go on to receive revision TKA, while 25 cases (29%) required implantation of another spacer. Of the 7 patients who required ≥3 spacer implantations, 3 went on to amputation, 3 had knee fusion, and 1 remained on chronic antibiotic therapy. Patients who failed tended to have multiple causative organisms ($p<0.01$). The most common causes of infection were multiple organisms (21.8%) and MRSA (19.5%). 52% of patients who received articulating spacer required either femoral or tibial augments, or both, compared to just 28% in the static spacer group ($p=0.04$). Of the 54 patients with articulating spacers, 40 had cleared the infection at latest follow-up, compared to 17/32 patients with static spacers ($p=0.08$). Overall, 57% of the patients had positive outcome with revision TKA, 17% underwent fusion; 9.3% had amputation, and 4% had amputation. The average knee flexion was 95.3°. The overall failure rate was 33.7%.

DISCUSSION AND CONCLUSION: Articulating antibiotic spacers showed greater effectiveness in clearing infection when compared to static spacers. However, they were associated with a greater use of augments, as well as decreased ROM and increased pain on follow-up. Organism isolated from the infected knee may play an important role in the effectiveness of the antibiotic spacer to eradicate infection.

Does an Anterior-Lipped Tibial Adequately Substitute for a Post-Cam Articulation in Total Knee Arthroplasty?

Abstract ID: Poster 042

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INTRODUCTION: Newer tibial inserts with enhanced conformity or an anterior lip to obviate the need for a PS cam-post articulation or PCL have been recently introduced in modern TKA. The purpose of this study was to determine whether clinical outcomes differ between TKAs with an anterior-lipped or PS cam-post articulation.

METHODS: A retrospective, matched-cohort review was performed in TKAs of a modern design implanted with either an anterior-lipped tibial insert or PS cam-post articulation. The PCL was resected in all patients regardless of articulation type. Patients with any previous open surgery on their knee were excluded. Modern Knee Society Scores (objective, functional, and satisfaction components), walking and stair pain, EQ5D and UCLA activity level were assessed at minimum one-year followup. Statistical analysis was performed with student t-tests for normal distribution and $p < 0.05$ as significant.

RESULTS: After exclusions, there were 43 anterior-lipped and 39 PS TKAs available for analysis. Demographic variables in each cohort were statistically matched and therefore not different between groups. Preoperatively, there were no differences between the groups with numbers available except in KSS function scores, where the anterior-lipped group presented with higher function ($p = 0.05$). At latest follow-up, the PS group demonstrated greater mean flexion of 5° ($p = 0.04$); however, there were no differences between groups in all other outcome measures with numbers available ($p > 0.35$). Both the anterior-lipped and PS TKA groups reported that 81% of patients were satisfied.

CONCLUSIONS: This study supports the hypothesis that an anterior-lipped insert is an adequate functional substitute for a post-cam articulation in patients undergoing TKA with PCL excision. These findings suggest that a PS post-cam articulation may not be necessary given the introduction, availability, and clinical performance of anterior-lipped and more conforming tibial bearings. Further study and longer-term follow-up is warranted.

SHOULDER

The Impact of Pre-Draft Ulnar Collateral Ligament Reconstruction on Future Performance in Professional Baseball: A Matched Cohort Comparison

Abstract ID: Poster 043

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INTRODUCTION: Although it is generally thought to have a negative impact on future potential, little is known about the influence of UCL reconstruction on the future professional career of baseball players who undergo surgery prior to being drafted. The purpose of the current study was to better understand the demographics, longevity, and success of these athletes compared to healthy, matched controls.

METHODS: With the assistance of Major League Baseball (MLB), the MLB Amateur Draft Database was queried to identify all drafted players who underwent UCL reconstruction prior to being drafted. For every pitcher drafted from 2005 to 2013 who had undergone pre-draft UCL reconstruction, 3 healthy controls with no history of elbow surgery were identified for matched control analysis. Controls were matched for position, draft year, draft round, draft selection, school level when drafted, and geographic region of their high school. A number of comparisons were made between the pre-draft UCL reconstruction group and the controls including: highest professional level reached, time required to progress to different levels of play, and statistical performance for those reaching the MLB Level.

RESULTS: A total of 333 players (318 pitchers and 15 position players [PP]) had undergone UCL reconstruction prior to being drafted. The overall survivorship for pitchers was 4.2 years vs. 5.2 years for PP ($p=0.323$). The annual number of pitchers and PP undergoing pre-draft UCL reconstructions rose steadily from 1990 to 2014 ($p<0.001$ and $p=0.001$, respectively). For the 252 pre-draft UCL reconstruction pitchers drafted from 2005 to 2013, 756 drafted healthy controls without UCL reconstruction were identified. Compared to controls, the pre-draft UCL reconstruction group reached the MLB level with greater frequency than controls (15.1% vs. 9.3%, $p=0.013$). For those reaching the MLB, the pre-draft surgery group played in more games (mead difference of 15.8), but their percentage of games started was lower (11.5% vs. 24.0%, $p<0.001$). Compared to all drafted players, pre-draft UCL reconstruction players demonstrated an increased likelihood of reaching progressive levels of play (Full Season A, AA, and MLB) within a given time frame ($p<0.05$ for all).

DISCUSSION AND CONCLUSIONS: Contrary to common belief, professional pitchers who underwent UCL reconstruction as amateurs appear to perform at least as well as, if not better, than matched controls without surgery. This data may prove beneficial for medical professionals treating these athletes and counselling players, parents, coaches, and professional teams.

Circulating Biomarkers of Bone Metabolism in Shoulder Arthroplasty Patients Undergoing Revision Surgery for Implant Loosening

Abstract ID: Poster 044

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With increased volumes of shoulder arthroplasty being performed worldwide, there is interest in developing assays that can enhance decision making regarding the need for revision procedures. Component loosening remains as an important clinical challenge in shoulder arthroplasty and is one potential target for the development of prognostic assays. The purpose of this study was to compare the levels of circulating biomarkers associated with bone metabolism in patients with well-functioning shoulder arthroplasty components versus patients scheduled for revision arthroplasty due to component loosening, or implant failure. Twenty participants were recruited into the study, 19 having received a primary shoulder arthroplasty for treatment of osteoarthritis (OA) and one for a proximal humerus fracture. The experimental group (n=10) consisted of participants suffering prosthesis failure and scheduled for revision shoulder arthroplasty. The control group (n=10) consisted of participants with no prosthetic complications. Patients were selected so that the mean postoperative times were comparable (4 years +/- 2 months). Serum samples were collected and quantitatively assayed by ELISA for bone alkaline phosphatase (BAP), pro-collagen type I c-terminal peptide (PICP), osteoprotegerin (OPG), and parathyroid hormone (PTH). This data was then compared to the presence of loosening as assessed intraoperatively, lifestyle factors, and degree of loosening measured radiographically. A ten point radiographic scale was used to assess the severity of component loosening. There was no statistical differences between the two groups in terms of BMI (P=1.00) or gender (P=0.910), though patients undergoing revision were significantly younger ($p<0.001$) than patients with well-functioning implants. In radiographic analysis, the experimental group exhibited significantly more total radiographic findings of component loosening (4/10) as compared to the control group (0.9/10) ($P=<0.001$). Patients with well-functioning implants demonstrated higher levels of BAP (1.05 ng/mL vs. 0.91 ng/mL), PICP (0.47 ng/mL vs. 0.45 ng/mL) and PTH (69.67 ng/mL vs. 42.8 pg/mL), but lower OPG (23.6 pg/mL vs. 31.1 pg/mL), though these differences were not statistically significant. Serum biomarker levels did not correlate with radiographic parameters or intraoperative findings of loosening. As component loosening remains a common cause for revision shoulder arthroplasty in patients without infection, a panel of biomarkers focused on bone metabolism could provide prognostic information to physicians. Patients with well-functioning implants tended to have higher levels of markers associated with bone anabolism, though these findings did not correlate with radiographic observations and failed to achieve significance. Our group is currently incorporating additional circulating markers that are indicative of bone catabolism, such as tartrate-resistant acid phosphatase-5b and cross-linked c-terminal and n-terminal peptides of type I collagen.

What are Patient Factors Associated with Prolonged Opioid Use After Rotator Cuff Repair?

Abstract ID: Poster 046

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BACKGROUND: Rising perioperative opioid use in the Unites States is of increasing concern for surgeons and healthcare systems. The purpose of this study was to evaluate patient factors that may be associated with postoperative opioid use following arthroscopic rotator cuff repair (RCR). We hypothesized various patient comorbidities would lead to prolonged opioid use in the postoperative period.

METHODS: All arthroscopic RCRs performed in the Humana Inc. database between 2007-2014 were identified using CPT code (29827). We evaluated the following patient risk factors for association with prolonged postoperative opioid use: (1) preoperative opioid use, (2) diagnoses of depression or anxiety, (3) low back pain, and (4) fibromyalgia. Patients were considered preoperative opioid users (POU) if they had filled an opioid prescription in the 3 months preceding surgery. Rates of postoperative opioid use were trended following surgery for 1 year. Risk ratios (RR's) with 95% Confidence Intervals (CI) were calculated to determine significance.

RESULTS: During the study period, 35,155 arthroscopic RCRs were performed. Of these, 43% (15,230/35,155) had been prescribed opioid pain medications in the three months prior to surgery. At 2 months after RCR, those who had been prescribed preoperative opioids were 4.03 (CI=3.82-4.24) times more likely to be filling opioid medications compared to those who had not been prescribed opioid medications prior to surgery. Patients with psychiatric diagnoses of anxiety and depression refilled opioid medications more frequently than those without a psychiatric diagnoses (RR=1.94, CI=1.85-2.04) at 2-3 months after rotator cuff repair. Those with myalgia (RR=1.67, CI=1.6-1.75) and low back pain diagnoses (RR=2.09 , CI=2-2.2) were also found to be at risk for filling opioid prescriptions at 2-3 months postoperatively.

DISCUSSION AND CONCLUSIONS: Prior to RCR, 43% of patients are filling opioid medication prescriptions. This is concerning as this factor was most strongly associated with high narcotic use during the first year after surgery. Patients with psychiatric diagnoses, fibromyalgia, and low back pain may also be counseled that they are at increased risk for tapering off narcotics after surgery. These data may provide a baseline for future improvements aimed at limiting opioid use after arthroscopic RCR.

The Use of PROMIS in Patients Undergoing Primary Total Shoulder Arthroplasty

Abstract ID: Poster 047

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INTRODUCTION: Patient-reported outcome instruments (PROs) provide patients an opportunity to communicate their level of function and quality of life to physicians. The Patient-Reported Outcome Measurement Information System (PROMIS) consists of question banks for various health domains and enables computer adaptive testing (CAT) from domain specific question banks. We hypothesized in patients that (1) there would be moderate to high correlation between both the PROMIS upper extremity item bank (PROMIS UE) and the PROMIS physical function CAT (PROMIS PF CAT); (2) PROMIS PF CAT would not demonstrate ceiling effects.

METHODS: Sixty-one patients with operative shoulder osteoarthritis were included. Each patient filled out the American Shoulder and Elbow Surgeons Shoulder Assessment Form (ASES), Marx Shoulder Activity Scale (Marx), Short Form 36 Physical Function subscale (SF-36 PF), EQ-5D, Western Ontario Osteoarthritis Shoulder Index (WOOS), PROMIS PF CAT and the PROMIS UE. Using Spearman correlation coefficients, correlation was defined as high (>0.7), moderate (0.4-0.6), and weak (0.2-0.3). Significant floor and ceiling effects were present if 15% of individuals scored the lowest or highest possible total score on a PRO.

RESULTS: Of 53 patients included, 22 (41.5%) were female and 31 (59.5%) were male. Average age was 61 years ± 12.9 years and BMI was 33.87 ± 6.8 kg/m2. The PROMIS UE demonstrated moderate correlation with ASES (r=0.55, P < 0.0001), SF-36 PF (r=0.53, P < 0.0001), EQ5D (r=0.48, P=0.002), and low correlation with WOOS sports (r=0.31, P=0.01) and with Marx (r=0.06, P=0.62). The PROMIS PF CAT demonstrated high correlation with ASES (r=0.62, P < 0.0001), SF-36 PF (r=0.81, P < 0.0001), EQ5D (r=0.64, P < 0.001), moderate correlation with WOOS sports (r=0.49, P=0.01) and low correlation with Marx (r=0.29, P=0.02). There were no ceiling or floor effects observed. The mean number of items administered by the PROMIS PF CAT was 4 (range 4-6; median 4).

DISCUSSION AND CONCLUSION: PROs play a key role in evaluation of patients and maintain communication between patients and surgeons. We hypothesized there would be moderate to high correlation between both the PROMIS UE and PROMIS PF CAT and that the PROMIS PF CAT would not demonstrate ceiling effects. The data suggest that PROMIS UE and PROMIS PF CAT may be a valid PRO alternative that has high correlation with traditional shoulder and upper extremity PROs. Additionally, PROMIS PF CAT offers a decreased question burden with no ceiling effects in an older patient population.

Gaining Infraspinatus Branch Length to Facilitate Direct Nerve Transfer of a Triceps Branch to the Suprascapular Nerve for Targeted Reinnervation of the Infraspinatus: A Feasibility Study

Abstract ID: Poster 048

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INTRODUCTION: Restoration of shoulder external rotation remains a significant challenge following upper brachial plexus injury. Transfers of spinal accessory nerve to suprascapular nerve (SSN) have been performed with generally poor outcomes. Recent literature suggests that transfer of radial or axillary nerve (AXN) branches may provide a more suitable transfer to re-innervate infraspinatus. This cadaveric study was undertaken to demonstrate proof-of-concept for a novel transfer between radial branches to long head of triceps and SSN.

METHODS: Seven fresh frozen cadaver specimens (14 sides) without any previous shoulder and elbow surgery were used for the study. Bilateral shoulders and proximal arms were dissected in the prone position with arms placed at 20° of shoulder abduction. Key elements of the technique involved isolation of the SSN immediately distal to its supraspinatus motor branch near the suprascapular ligament. The pedicle was then delivered through the spinoglenoid notch and deep to infraspinatus for emergence in the infraspinatus-teres minor interval. Branches of radial nerve to long head of triceps were isolated as they required the least amount of upper arm dissection for isolation. In two specimens (four sides), anastomosis was attempted between SSN and the branch of AXN to the posterior deltoid; this was too short for co-aptation in each case.

RESULTS: Nerve overlap between SSN and radial nerve branch of at least 21 mm was observed in all 14 dissected sides. Mean nerve overlap was 26 mm (range 21–32 mm). Mean SSN length was 59 mm (range 50–80 mm). Mean SSN interval length was 28 mm (range 21–45 mm). Mean length of the long head of triceps branch was 72 mm (range 65–85 mm). When posterior branch of AXN was transferred to the SSN, a mean gap of 12 mm (range 8–15 mm) was observed.

CONCLUSIONS: Transfer of long head of triceps radial nerve branches to infraspinatus branch of SSN is possible with isolation of the SSN immediately distal to the supraspinatus motor branch. This technique enables tension-free co-aptation without the need for interposition nerve grafts. Proof-of-concept from this study requires formal clinical evaluation to assess efficacy for restoration of shoulder external rotation in upper brachial plexus injury. A limitation of this technique is the necessity to dissect portions of lateral trapezius and posterior deltoid; however, dissection of SSN proximally toward the suprascapular ligament is critical to achieve adequate recipient nerve length.

Management of Fixed Prosthetic Dislocations Following Primary Anatomic Shoulder Arthroplasty

Abstract ID: Poster 49

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INTRODUCTION: The success of anatomic total shoulder arthroplasty (TSA) is dependent on properly functioning and well balanced soft tissues. Failure of this may lead to a spectrum of instability from mild subluxation to fixed dislocation, with varying degrees of disability. Data regarding management of frank prosthetic shoulder dislocations is scarce since the introduction of the reverse shoulder prosthesis in the United States in 2005. We sought to assess the management and outcomes of patients with a fixed dislocation following anatomic TSA.

METHODS: Between 2000 and 2013, 1946 primary anatomic TSAs were performed at our institution. We identified 16 fixed dislocations that were managed between 2005 and 2016. Mean age at index arthroplasty was 67 years (range, 45 to 82 years). Our cohort included 75% females. Indication for TSA was osteoarthritis in 10, inflammatory arthritis in 3, instability in 1, nonunion in 1, and malunion in 1. The deltopectoral approach was used uniformly and the subscapularis tendon was repaired in 15 of 16 shoulders. We assessed time to dislocation and initial management, as well as recurrent dislocation, need for revision surgery, and final clinical outcomes.

RESULTS: Mean time to dislocation was 19.5 months (range, 0 to 108 months), with 44% (7/16) of dislocations occurring in the first 90 days. Eight were anterior, while 8 were posterior. Two patients underwent closed reduction with general anesthesia, 1 required open reduction alone, 4 underwent open reduction with revision of the humeral component along with soft tissue procedures, and the remaining 9 underwent conversion to reverse shoulder arthroplasty (RSA). One patient suffered a fatal pulmonary embolism 3 weeks following RSA. At an average follow-up of 41 months following dislocation, pain relief was noted in 13 of 15 shoulders (patient with PE excluded) with no recurrent frank dislocations following intervention. One patient had persistent pain with humeral loosening requiring re-revision. Closed reduction was elected for two patients given several comorbidities, and both reported persistent pain and limited function at final follow-up. 60% (9/15) had an unsatisfactory modified Neer rating due to limitations in range of motion.

CONCLUSIONS: A fixed anterior or posterior dislocation following anatomic TSA is a rare but serious complication, often requiring revision surgery. Revision TSA with soft tissue procedures or RSA are reasonable options to prevent further dislocations; however, patients should be counseled regarding limitations in function.

Management of Instability Following Primary Reverse Total Shoulder Arthroplasty

Abstract ID: Poster 050

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BACKGROUND: Instability is an uncommon, but dreaded complication following primary reverse total shoulder arthroplasty (RTSA). Due to the low incidence of instability, there is a lack of evidence on appropriate management. This study assessed patient outcomes following dislocation of a primary RTSA.

METHODS: We performed a retrospective review of 1870 primary RTSAs performed at our institution between January 2004 and May 2016. 18 shoulders were identified with radiographically proven dislocations (incidence, 0.96%). Mean age at the time of index arthroplasty was 69.5 years (range, 45-89 years) and 72% of patients were male. Variables studied included time to dislocation and initial management (closed versus open), as well as recurrent instability and need for revision surgery.

RESULTS: Mean time to first dislocation was 211 days, with 72% (13/21) of dislocations occurring in the first 90 days. 9 shoulders were managed with closed reduction, 8 shoulders with revision RTSA, and 1 with open reduction. 44% of shoulders (4/9) managed with closed reduction and 22% (2/9) managed with open procedures had recurrent instability, and went on to revision or re-revision. At last follow-up (mean, 16 months from dislocation), 66% (12/18) had a stable revision implant , 22% (4/18) had a stable primary implant, 6% (1/18) had chronic instability, and 6% (1/18) had gone on to resection arthroplasty. There were no significant differences in outcome between early and late dislocation, or closed and open treatment.

CONCLUSION: Dislocation after primary RTSA portends a poor prognosis with 78% of the patients in the current series ultimately requiring revision surgery. Closed reduction should be attempted when possible as this study demonstrated similar outcomes following either closed or open management.

Early Outcomes of Reverse Total Shoulder Arthroplasty According to Gender

Abstract ID: Poster 051

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PURPOSE: To report on gender specific early outcomes of RSA in a large cohort of patients who were followed for a minimum of 2 years.

METHODS: A multi-center prospective cohort of 495 patients (258 females, 237 males) treated with RSA from 2007 to 2014 was retrospectively analyzed. Mean follow-up was 38.5 months. Outcomes were assessed using ASES, SPADI, Constant, UCLA, and SST scores; active abduction, forward flexion, and internal/external rotation were also measured to quantify function.

RESULTS: Female patients underwent RSA at a significantly older age (73.6 years) than the average age of males (70.8 years); $p < 0.001$. Female patients begin with lower preoperative outcome scores when compared to males in ASES (33.3 versus 42.2; $p < 0.001$), Constant score (30.9 versus 37.6; $p < 0.001$), UCLA score (12.4 versus 14.3; $p < 0.001$), SST (2.6 versus 4.3; $p < 0.001$) and VAS (6.1 versus 5.4; $p < 0.001$). The only difference in preoperative function was found in active abduction, in which males displayed greater abduction ($74.3 \pm 36°$) when compared to females ($65 \pm 33°$); $p = 0.001$. Postoperatively, both groups reported high satisfaction with their procedures. Female patients maintained lower overall outcome scores with regards to ASES score (81.1 versus 86.1; $p < 0.001$), Constant score (67.3 versus 72.4; $p < 0.001$), UCLA score (29.3 versus 30.2; $p = .03$), and SST score (9.4 versus 10.5; $p < 0.001$). Postoperative abduction was greater in males than females (114.9 versus 109.0; $p=0.01$). Otherwise, there were no other clinically significant differences in postoperative range of motion (ROM) between sexes. When evaluating overall improvement from preoperative values, females had significant improvements internal rotation (1.75 levels versus 1.1 levels; $p < 0.01$) compared to males. Otherwise, we found no statistical differences between the groups, and both had equal improvement of function and outcomes scores when compared to their preoperative values.

DISCUSSION AND CONCLUSION: This study found that female patients undergo RSA at a later age than males, and begin with worse shoulder abduction and outcome scores. While females have lower final outcome scores compared to males, there is no significant difference in absolute improvement from preoperative to postoperative function and outcome scores. This suggests that there is no difference in functional improvement or outcomes based on gender. Patients can be informed to expect equal improvements in function and outcomes regardless of their gender when undergoing RSA.

Shoulder Arthroplasty in Transplant Recipients: Complications and Mortality

Abstract ID: Poster 052

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PURPOSE: The incidence and survivability of those with solid organ transplantations in the United States continues to increase. These patients can be expected to develop conditions about the shoulder girdle which may progress to require humeral hemiarthroplasty or total shoulder arthroplasty. The purpose of this study is to identify inpatient, 30, and 90-day outcomes following shoulder arthroplasty in transplant recipients.

METHODS: The Healthcare Cost and Utilization Project State Inpatient Databases for California, Florida, Iowa, and New York were used to identify patients who underwent either hemiarthroplasty or shoulder arthroplasty after one or more solid organ transplants between the years 2007-2013. Patients were matched by propensity scores based on patient demographic and clinical factors. International Classification of Diseases, Ninth Revision, codes were used to define the primary composite outcome of death or postoperative complication. Logistic models with frequency weights were used to compare propensity matched groups.

RESULTS: 48,742 patients met inclusion criteria. Of these, 125 patients had a history of solid organ transplant. After matching these patients to non-transplant counterparts, the final analytic cohort was 125 in the transplant group and 593 in the non-transplant group. Patients with transplants had increased odds of inpatient (OR 1.62, 95% C.I. 1.04 – 2.51), 30 day (OR 1.56, 95% C.I. 1.01 – 2.40), and 90 day (OR 1.64, 95% C.I. 1.08 – 2.51) complications compared to non-transplant patients. At all time points, transplant patients had an increased risk of respiratory complications ($p < .05$). Transplant patients also had increased odds of inpatient hemorrhagic complications (OR 1.83, 95% C.I. 1.09 – 3.08). Transplant patients did not have an increased risk of surgical site infection or mortality at any time point. Length of hospital stay was increased in the transplant group (4.5 vs. 3.2 days, $p=0.009$).

CONCLUSIONS: This is the first series examining early postoperative complications and causes for readmission in patients who underwent primary shoulder arthroplasty following solid organ transplant. Transplant recipients are at elevated risk of inpatient, 30, and 90 day postoperative complications and tend to have longer length of stays. These findings emphasize the importance of preoperative evaluation and risk mitigation, especially with regards to the pulmonary system. While it is important to acknowledge these patients are immunocompromised and more susceptible to postoperative complications, the risk of infection may not be elevated in the early postoperative period.

Effect of Chronic Narcotic Use on Episode of Care Outcomes Following Primary Anatomic Total Shoulder Arthroplasty

Abstract ID: Poster 053

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BACKGROUND: Chronic narcotic use has been investigated on outcomes for total knee arthroplasty and spinal surgeries. However, there is little information regarding this on early outcomes following anatomic total shoulder arthroplasty (TSA). Also, bundled care payments for TSA may make early outcomes more relevant as these plans are typically tied to a 90-day episode of care. The purpose of this study is to determine the effect of chronic preoperative narcotic use on early postoperative pain relief, narcotic use, length of stay (LOS), and complications in patients undergoing primary TSA.

METHODS: After IRB approval, our institutional database was searched for patients undergoing primary anatomic TSA. Chronic narcotic use was defined as patients taking narcotic pain medication for 3 months or more preoperatively. Visual Analog Scale (VAS) pain scores, LOS, and complications were determined. Narcotic use was converted to oral morphine equivalents (OME) for in-hospital use, discharge medications, and prescriptions at 2-, 6-, and 12-week visits. The state-wide narcotic prescriptions database was also queried. Statistical analyses included Fishers exact tests for dichotomous variables and students t-test for continuous variables. Differences between groups with $p<0.05$ were considered statistically significant.

RESULTS: Our search returned 152 shoulders undergoing primary TSA. There were 27 shoulders with and 125 shoulders without chronic preoperative narcotic use. There were no statistically significant differences between groups in age, gender, laterality, or body mass index. At 2 weeks postoperatively, there was no significant difference in VAS scores between groups (4.7 vs. 3.8, $p = 0.08$). However, at 6 and 12 weeks, chronic narcotic users had significantly higher VAS scores (4.1 vs. 2.3, $p = 0.001$; 2.8 vs. 1.6, $p = 0.02$ respectively). The chronic narcotic use group also had a significantly higher cumulative narcotic requirement (3209 mg vs. 1814 mg, $p = 0.003$). Regarding LOS, complications, and readmissions; there were no significant differences between groups (1.4 vs. 1.2 days, $p=0.31$; $p = 0.67$ and 0.23, respectively).

CONCLUSIONS: Patients using chronic preoperative narcotic pain medication had significantly higher VAS scores and narcotic requirements following anatomic TSA. There were no significant differences between groups with regard to LOS, complication rate, or readmission rate. These results identify chronic preoperative narcotic use as a risk factor for a more difficult postoperative course following TSA compared to narcotic naïve patients. However, these patients do not necessarily require additional perioperative resources, which is relevant to risk stratification in the emergence of bundled payment programs for TSA.

Tobacco Use Predicts a More Difficult Episode of Care After Anatomic Total Shoulder Arthroplasty

Abstract ID: Poster 054

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BACKGROUND: Primary total shoulder arthroplasty (TSA) provides predictable pain relief and postoperative outcomes. However, studies investigating patient-specific risk factors, including tobacco use, that may predict early postoperative outcomes are lacking. We proposed to evaluate postoperative pain, narcotic use, length of stay, and complications in patients following total shoulder arthroplasty who are either current tobacco users, non-users, or former users.

METHODS: The records of primary anatomic total shoulder arthroplasties performed by a single surgeon at our institution were reviewed for demographic, clinical, and diagnostic data.

RESULTS: 163 primary TSAs meeting inclusion criteria were identified. At 12 weeks postoperatively, VAS scores decreased from 7.1 to 4.3 ($p<0.001$) in the tobacco use group, 5.8 to 1.8 ($p<0.0001$) in the no tobacco use group, and 5.8 to 1.5 ($p<0.0001$) in the former tobacco users. Average VAS score at 12 weeks was significantly higher in the current tobacco group (4.3 vs. 1.8 and 1.5, $p<0.0001$) and the improvement in VAS was significantly less in the current tobacco cohort (2.8 vs. 4 and 4.3, $p<0.02$). Cumulative OME use at 12 weeks was significantly higher in the current tobacco use group when compared to non-users and former users (2348 mg vs. 1637 mg and 1623 mg, $p<0.003$). There was a trend towards longer length of stay for the current tobacco use group versus the former tobacco use group (1.21 days vs. 0.95 days, $p=0.08$). No significant differences regarding complication rates (18% vs. 11% and 8%, $p=0.35$ and $p=0.28$), re-operation rates (7% vs. 3% and 2%, $p=0.59$ and $p=0.29$), or hospital readmissions.

CONCLUSIONS: Current tobacco use is a significant predictor of increased postoperative pain and narcotic use in the global period following TSA. Though length of stay, complication rates, hospital readmissions, and re-operation rates were not significantly different, tobacco users in general required more perioperative resources than non-users or former users. As risk stratification models evolve for bundled payment plans, current tobacco use should be identified as a predictor of a more difficult postoperative course. Former tobacco users were found to have a similar postoperative course as non-users, suggesting that discontinuation of tobacco use can improve a patient's episode-of-care performance following total shoulder arthroplasty.

Outpatient Shoulder Arthroplasty Patients Express High Levels of Satisfaction

Abstract ID: Poster 055

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BACKGROUND: Outpatient shoulder arthroplasty has recently been shown to be a safe alternative to hospital admission in appropriately selected patients. However, little is known regarding patient perceptions of the procedure in this setting. We proposed to evaluate patient reported satisfaction with outpatient shoulder arthroplasty performed in a free-standing ambulatory surgery center (ASC).

METHODS: Following Institutional Review Board approval, patients undergoing primary outpatient shoulder arthroplasty were mailed a custom survey. The questions addressed patient satisfaction regarding the surgery and location utilizing a 5 point Likert scale. Satisfaction with the ASC environment versus a hospital was assessed with a nominal scale. Patients were also asked whether they would have the surgery again utilizing a nominal scale. All patients were more than 90 days removed from their procedures at the time of survey. Patients who did not respond by mail were subsequently contacted by telephone to provide complete data.

RESULTS: Twenty patients completed the survey; there were 17 anatomic total shoulder arthroplasties (TSA) and 3 reverse total shoulder arthroplasties (RTSA). Of the 20 respondents, 19 (95%) were “extremely” or “very” satisfied with their experience at the ASC and all 20 patients would consider having surgery at the same center again. Additionally, 19 patients (95%) were happy the procedure was done at an ASC rather than at a hospital. Seventeen of 20 (85%) were “extremely” or “very” satisfied with their surgery overall and one patient (5%) would not have the surgery again.

CONCLUSION: Patients undergoing outpatient shoulder arthroplasty expressed high levels of satisfaction with the operation in the ASC environment. Further, patients were happy to avoid hospital admission following the procedure. And most patients would repeat the experience if given the opportunity. These data suggest that patients perceive outpatient shoulder arthroplasty to be a preferable alternative to the traditional inpatient setting.

Reverse Shoulder Prosthesis in the Treatment of Locked Anterior Shoulders: A Comparison to Classical Reverse Shoulder Indications

Abstract ID: Poster 056

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BACKGROUND: Locked anterior shoulders (LAS) with static instability and anterior glenoid bone loss are challenging in the elderly population. Reverse shoulder arthroplasty (RSA) has been employed in treating these patients. No study has compared RSA for LAS to classically indicated RSA.

METHODS: A case-control study of patients treated with RSA for LAS with glenoid bone loss and static instability was performed using matched controls treated with primary RSA for classic indications. Twenty-four cases and 48 controls were evaluated. Average follow-up was 25.5 months and median age was 76. Motion, outcome assessments, and postoperative radiographs were compared.

RESULTS: Preoperatively, LAS had significantly less rotation and lower baseline outcome scores. Glenoid bone grafting was more common (p=0.05) in control group (26%) than LAS group (6.3%). Larger glenospheres were utilized more often (p=0.001) in LAS group (75%) than control group (29%). Both groups demonstrated significant improvements in pain, function, and outcome scores. Postoperatively, control group had significantly better elevation and functional outcome scores. With the exception of flexion and SST, effectiveness of treatment was similar between groups. Postoperative acromion stress fractures were seen in 21% of LAS and 9% of control (p=0.023) with a predominance of type 3 fractures in LAS. Two LAS patients remained dislocated.

CONCLUSION: Treatment with RSA for LAS may anticipate improvements in pain and function using larger glenospheres often without the need for glenoid bone grafting. Worse postoperative motion, function, and a higher incidence of acromion stress fracture may be expected.

Use of Skive Screws for Peri-Prosthetic Humeral Shaft Fractures

Abstract ID: Poster 057

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BACKGROUND: Peri-prosthetic humerus fractures are relatively uncommon occurrences that can be difficult to manage non-operatively. Locking plate technology has enhanced the surgical management of these fractures. We describe an osteosynthesis technique utilizing a locking plate with eccentrically placed screw holes to place 'skive screws' in the proximal end of the plate to achieve fixation around the stem of the implant.

METHODS: A retrospective review of prospectively collected data was performed for a consecutive series of patients treated with this skive screw technique from May 2011 to September 2014. Seven patients presented with postoperative type B peri-prosthetic humerus fractures. Average follow-up was 24 months. Radiographic analysis was performed on most recent postoperative imaging. Clinical outcomes were assessed using VAS pain, ASES total score, ASES functional score, SST, SANE, range of motion, and strength.

RESULTS: At an average of follow-up of 24 months, all patients demonstrated fracture healing. Functional outcomes were limited with only two patients achieving forward elevation above 90° and average ASES Function score was 27.5. Pain relief was nearly uniform with an average VAS Pain score of 0.5.

CONCLUSIONS: Peri-prosthetic humeral shaft fractures can be successfully treated with hybrid fixation technique using a locking plate with eccentric holes that facilitate placement of proximal 'skive screws'. Using this technique, a 100% union rate was observed with excellent pain relief.

Optimal Method of 3-Dimensional Preoperative Planning to Select Humeral Head Implant Size and Thickness in Total Shoulder Arthroplasty

Abstract ID: Poster 058

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INTRODUCTION: Preoperative planning and patient-specific instruments have grown in popularity across a wide range of orthopedic subspecialties to improve the accuracy of implant selection and positioning. Recent literature on total shoulder arthroplasty (TSA) has focused on patient specific instrumentation found to improve glenoid component placement; however, few studies have focused on these methods to optimize selection of humeral components. The purpose of our study was to examine optimal methods of preoperative planning using 3 dimensional simulation software for selection of humeral component in TSA.

METHODS: A retrospective analysis was completed of 12 patients who underwent a total shoulder arthroplasty with preoperative computerized tomography studies and preoperative planning simulations. A detailed independent preoperative planning simulation (IPPS) (OrthoVis) was performed and compared to automized manufacturer preoperative simulation (AMPS) (ArthrexVIP) recommendations and intraoperative implant selection which were blinded from preoperative simulation recommendations. The previously described “best fit sphere” method was utilized to identify anatomic radius of curvature and optimal humeral head size for TSA. Neck to highest point on humeral head was measured to assess optimal humeral head thickness. Using paired statistical t tests, the plans were compared to each other and to the actual surgical implant used to determine significant differences and predictability of the actual implant based on preoperative planning. P-values < 0.05 were considered significant.

RESULTS: The difference between average IPPS humeral best-fit sphere of 49.97 mm compared to recommended AMPS plan size of 50.10 mm ($p=0.757$) was not statistically significant. The best-fit sizes (IPPS vs. AMPS) compared to the average intraoperative implant size, 50.50 mm ($p=0.367$; $p=0.185$) were also not significantly different. For humeral head thickness the IPPS measured value was on average 19.50 mm, which was not significantly different than the average intraoperative head thickness selected of 19.08 mm ($p=0.508$). Overall, there was a high correlation between both methods of preoperative humeral head size measurements (IPPS vs. AMPS) and intraoperative implant selection for humeral head size ($R=0.843$, $R=0.867$) but little correlation between IPPS humeral head thickness and intraoperative humeral head thickness ($R=-0.066$).

DISCUSSION: Our results support the use of either commercially available or independent preoperative planning simulations software to guide intraoperative humeral head implant size but not thickness. Consideration still needs to be made in assessing soft tissue tensioning when selecting optimal humeral head thickness intraoperatively. Still utilizing these innovative tools and improving our methods can improve intraoperative efficiency and recreation of the anatomic joint to optimize results for TSA.

Pain Assessment After Shoulder Arthroplasty: Anatomic Total Shoulder Arthroplasty vs. Reverse Total Shoulder Arthroplasty

Abstract ID: Poster 059

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BACKGROUND: As anatomic total shoulder arthroplasty (aTSA) and reverse total shoulder arthroplasty (rTSA) become increasingly common, differences between the procedures are more clearly identified. However, differences in acute postoperative pain following these procedures have not been well studied.

PURPOSE/HYPOTHESIS: To determine differences in acute pain levels between patients undergoing a TSA vs. rTSA. Our hypothesis was that in patients undergoing shoulder arthroplasty, treatment with aTSA vs. rTSA would lead to no significant differences in acute postoperative pain levels.

METHODS: A total of 60 patients undergoing either aTSA or rTSA were assessed for participation. The primary outcome of the study was postoperative daily visual analogue scores, which were collected for 4 days. Secondary outcomes included opioid consumption, length of stay, and complications.

RESULTS: Three patients were excluded. A total of 57 patients were analyzed. There were no significant differences in postoperative visual analogue scores in the first 4 days following surgery. There was a non-significant trend toward higher VAS scores in the aTSA group in the first 8 hours postoperatively; mean ± SD 4.6 ± 3.1 vs. 3.0 ± 2.6 (0-4 hours), 4.1 ± 2.6 vs. 2.9 ± 3.1 (5-8 hours), ($p = .056$, $p = .167$, respectively). Patients undergoing aTSA had a significant increase in opioid requirements (morphine equivalents) in the first 4 hours postoperatively; 1.0 ± 0.7 vs. 0.4 ± 0.6, $p = .001$. There were no significant differences in length of stay or complications, and both groups reported high levels of satisfaction with pain control.

CONCLUSION: Patients undergoing anatomic total shoulder arthroplasty reported slightly higher pain levels and required significantly more opioid medication in the immediate postoperative period. Outside of the first 8 hours, there were no significant differences found in any variables. These findings suggest that patients undergoing aTSA or rTSA have similar postoperative pain profiles. Postoperative pain differences should not be a significant factor in deciding between the procedures.

The Effect of Mood Disorders on Early Outcomes Following Primary Reverse Total Shoulder Arthroplasty

Abstract ID: Poster 060

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BACKGROUND: Mood disorders such as depression and anxiety are highly prevalent in the general population. Though they are thought to be deleterious to patient outcomes, there is a paucity of information on their effect in patients undergoing shoulder arthroplasty. We proposed to study the effect of mood disorders on pain level, narcotic use, length of stay, and complications in the global postoperative period for patients undergoing primary reverse total shoulder arthroplasty (RTSA).

METHODS: After IRB approval, a database search was conducted for primary RTSAs at our institution. Patients were classified as having a mood disorder by documentation of depression/anxiety and/or use of a prescription mood-stabilizing drug. Visual analog scores (VAS), postoperative narcotic usage measured in oral morphine equivalents (OME), length of hospital stay, and complications were evaluated and compared between patients with and without mood disorders. Statistical analyses were performed using Fishers exact tests for dichotomous variables and students t-test for continuous variables. Differences with $p<0.05$ were considered statistically significant.

RESULTS: After database search, 162 primary reverse arthroplasties were included in the study. There were 48 shoulders in the mood disorder cohort and 114 shoulders without mood disorders. Demographically, patients with mood disorders were more likely to be younger (68.5 vs. 71.8 years, $p = 0.04$), female ($p = 0.01$), and had lower body mass index (28.2 vs 30.4, $p = 0.05$). There were no other differences between groups regarding operative indication, laterality, or comorbidities.

There were no significant differences between groups regarding VAS at any time point or in cumulative oral morphine equivalents (1385 mg vs. 1240 mg, $p = 0.32$). The average length of stay for the mood disorder group was 1.5 days while for the cohort without mood disorders it was 1.4 days ($p = 0.70$). Complication rates between groups were not significantly different (2.1% vs. 3.5%, $p=0.64$). There was a trend toward a significantly higher hospital readmission rate in the mood disorder group ($p = 0.051$).

CONCLUSIONS: Patients with mood disorders did not have significantly increased VAS scores or postoperative narcotic requirements following RTSA. Similarly, length of hospital stay and complication rates were not significantly different between groups. Though there was a trend toward a higher readmission rate in the mood disorder group, these results suggest patients with mood disorders can generally expect a similar recovery following RTSA as those without mood disorders.

Mood Disorders Do Not Predict a More Difficult Postoperative Course Following Primary Anatomic Total Shoulder Arthroplasty

Abstract ID: Poster 061

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BACKGROUND: Mood disorders, including depression and anxiety, are present in up to 30% of the population undergoing arthroplasty procedures. Information is lacking on the disorders impact following shoulder arthroplasty, particularly in the global postoperative period. This information will be increasingly relevant as bundled plans are typically tied to a 90-day episode of care. We proposed to study the effect of mood disorders on pain, narcotic use, length of hospital stay, and complications following primary anatomic total shoulder arthroplasty (TSA) in the global post-operative period.

METHODS: After IRB approval, a search of primary anatomic total shoulder arthroplasties at our institution was conducted. Patients in the mood disorders group were identified by the presence of depression and/or anxiety on intake forms or use of a mood stabilizer. Visual analog pain scores (VAS) were recorded at the preoperative visit and at 2-, 6-, and 12-week visits. Oral morphine equivalents (OME) were recorded for in hospital use, discharge medications, and prescriptions given at 2-, 6-, and 12-week visits. Length of stay and complications data were also recorded. Analyses performed included Fishers exact tests for dichotomous variables and students t-test for continuous variables. Differences with $p<0.05$ were considered statistically significant.

RESULTS: After database search, 134 primary anatomic total shoulder arthroplasties were identified. Thirty-two patients comprised the mood disorder group and the remaining 102 patients did not have a mood disorder. Patients with mood disorders were more likely to be female and undergo a left sided procedure ($p=0.0001$ and $p=0.03$, respectively). Otherwise there were no significant differences between groups regarding age, operative indication, BMI, or comorbidities.

There were no significant differences in VAS scores at the preoperative, 2-, 6-, or 12-week visits. There were also no significant differences between groups regarding OME narcotic use at any of the recorded time points. And no statistically significant differences were found between cohorts regarding length of hospital stay or postoperative complication rates.

CONCLUSIONS: We found no significant differences in VAS scores, postoperative narcotic requirement, length of hospital stay, or complications at any recorded time point. These results indicate that patients with a mood disorder undergoing total shoulder arthroplasty can expect a similar postoperative course as those without depression or anxiety. Further, this data suggests the presence of a mood disorder will not necessarily be a significant risk factor for bundled

payment plans to consider when developing modeling for primary anatomic total shoulder arthroplasty.

A Quantitative Analysis of the Effect of Glenoid Bone Volume on Baseplate Failure in Reverse Total Shoulder Arthroplasty

Abstract ID: Poster 062

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INTRODUCTION: Early concerns regarding baseplate failure in reverse total shoulder arthroplasty (RTSA) have been largely mitigated by improvements in implant design and surgical technique. However, failures can occur in the setting of advanced glenoid bone loss. This is particularly true in patients with inflammatory arthritis where bone quality is often compromised. The purpose of this study was to determine and compare the glenoid vault bone volumes in patients undergoing RTSA for inflammatory arthritis to determine if a threshold exists where baseplate fixation is at risk for failure.

METHODS: This study included 14 subjects (5 male, 9 female) who underwent primary RTSA for inflammatory arthritis. Ten of the 14 subjects underwent humeral head autografting (4 of 5 males and 6 of 9 females) to augment glenoid deficiency. Four subjects (2 male, 2 female) experienced baseplate failure with component pull-out from the glenoid. Preoperative computed tomography (CT) images of the subjects were imported into Mimics to measure glenoid vault volumes. Glenoid vault bone volumes for male failures versus non-failures and female failures versus non-failures were compared. An F-test was performed to check for equal variances between each group followed by a two-sided t-test to compare each group. Differences with $p < 0.05$ were considered statistically significant.

RESULTS: The average volume in females with baseplate failure was 3.5 cm^3 (SD = 2.1 cm^3) while the average volume in females without failure was 8.6 cm^3 (SD = 2.4 cm^3, $p = 0.03$). The average volume in males with baseplate failure was 11.8 cm^3 (SD = 2.0 cm^3) while the average volume in males without failure was 18.3 cm^3 (SD = 1.3 cm^3, $p = 0.02$). There were no baseplate failures in males with glenoid vault volumes greater than 14 cm^3 or in females with volumes greater than 5 cm^3.

DISCUSSION AND CONCLUSION: In this study, patients with baseplate failure after RTSA for inflammatory arthritis had significantly lower average glenoid vault volumes when compared to their intact gender-specific counterparts. These results suggest a horizon of glenoid bone volume below which baseplate fixation is potentially compromised. Specifically, male patients with glenoid vault volumes less than 14 cm^3 and female patients with glenoid vault volumes less than 5 cm^3 may be at higher risk for baseplate failure even with use of bone grafting to augment glenoid deficiency. Larger studies will be needed to further characterize these findings.

Short-Term Complications After Rotator Cuff Repair: Should We Still Perform Open Surgery?

Abstract ID: Poster 063

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BACKGROUND: Rotator cuff repair provides consistent pain relief and restores function in appropriately indicated patients. Surgical techniques include open, arthroscopic, or combined techniques, with a trend toward increasing utilizing arthroscopic procedures. The incidence of complications following rotator cuff repair are infrequent but not insignificant. Thus, the primary objective of the present study was to define the incidence and risk factors for short-term complications following arthroscopic and open rotator cuff repair.

METHODS: All patients who underwent open or arthroscopic rotator cuff repair between 2005 and 2013 were identified in the American College of Surgeons National Surgical Quality Improvement Program database. Short-term complications were categorized as major complications, minor complications, mortality, and unplanned 30-day readmission. Univariate analysis allowed comparison of patient demographic and health characteristics. Propensity score matching was used to control for demographic differences between arthroscopic and open repair cohorts. Independent risk factors for complication were identified using multivariate logistic regression.

RESULTS: Overall, 11,314 rotator cuff repairs were identified (24% open, 76% arthroscopic). The mean operative time for open rotator cuff repair was 78 minutes, as compared to 91 minutes for arthroscopic repairs ($p<0.001$). The overall complication rate was 1.3%. The most common complications included unplanned return to the operating room (41 patients [0.36%]), urinary tract infections (34 patients [0.30%]), surgical site infections (28 patients [0.25%]), pulmonary embolism (26 patients [0.23%]) and DVT/VTE (15 patients [0.13%]). The 30-day readmission was 1.16.% (76/6560 patients) and the mortality rate was 0.03% (3 patients). Total (30-day pooled) complications in the propensity score matched cohorts were higher following open repair (1.79%) versus arthroscopic (1.17%), which was significant ($p=0.006$). Multivariate analysis identified age >65 (OR 1.6; CI 1.2-2.3), operative time greater than 90 minutes (OR 1.5; CI 1.1-2.1), and open rotator cuff repair (OR 1.6; CI 1.1-2.3) as independent risk factors for complications.

CONCLUSIONS: Regardless of technique, short-term complications following rotator cuff repair are rare at just over 1%. However, several risk factors for complications were identified including patient age >65, operative time >90 minutes, and open repair technique. In patients of increasing age, surgeons should be efficient with operative time and use arthroscopic techniques to limit short-term complications after surgery.

SPINE

Pedicle Screw Pullout and Torque Using Calcium Polyphosphate Cement Compared to Conventional Cement Augmentation

Abstract ID: Poster 064

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PURPOSE: The purpose of our study was to compare the pullout strength and torque of conventional pedicle screws (CPS) augmented with either polymethalmethacrylate (PMMA) or Calcium Polyphosphate (CPP) cement in polyurethane foam blocks mimicking osteoporotic bone.

METHODS: Standardized low-density polyurethane open cell foam blocks were instrumented with conventional pedicle screws and were categorized into three groups of six each. Group 1 was the control group and no cement was used. Groups 2 and 3 were augmented with PMMA and CPP respectively. Groups 4-6 were instrumented in a similar fashion. An instron machine was used to apply an axial load to failure at a rate of 5 mm/min for three minutes for groups 1-3 and 1°/sec for groups 4-6. Failure was defined by an evident drop in the load after maximum value.

RESULTS: The PMMA and CPP were significantly greater than control $p < 0.0001$. Interestingly, there was no significant difference in the load to failure for the PMMA and CPP groups. PMMA was significantly greater than CPP and control. However, CPP was significantly greater than control group.

CONCLUSION: No difference was observed between PMMA and the biologically active CPP in axial pullout load to failure. However, PMMA had significantly higher torsional resistance than CPP, but both PMMA and CPP were significantly greater than control. Further investigation is warranted for this promising compound to increase its validity as a potentially safer and equivalent option for pedicle screw augmentation.

The Pelvis and the Spine: A Dynamic Relationship

Abstract ID: Poster 065

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INTRODUCTION: Pelvic parameters and position affect spinal alignment. To date, studies have only examined the static relationship between the pelvis and the spinal column. Our objective was to examine the dynamic effect of the pelvis on the spine and associated spinal and spino-pelvic parameters.

HYPOTHESIS: Spinal and spino-pelvic parameters will change as subjects alter their pelvic position.

DESIGN: Retrospective cohort of 50 asymptomatic volunteers.

INCLUSION CRITERIA:
-18-79 years of age
-No known spinal, pelvic, or lower extremity pain (>1-2 days)
-No history of spinal, pelvic, or lower extremity dysfunction
-No radiographic evidence of spinal or pelvic abnormality
-Not currently pregnant and with no possibility of being pregnant
-BMI < 30

METHODS: Each subject was instructed to stand in 3 different positions: resting, anterior rotation, and posterior rotation. Lateral standing radiographs were taken in each position, and an orthopedic spine surgeon digitally measured: thoracic and lumbar Cobb angles (TK and LL), pelvic tilt (PT), sacral slope (SS), and sagittal vertical axis (SVA).

RESULTS: Subjects demonstrated a change in each measured parameter with changing pelvic position. However, not all changes were statistically significant. TK and SVA almost uniformly demonstrated an insignificant change with anterior and posterior pelvic rotation. LL, PT, and SS almost uniformly demonstrated a statistically significant change with anterior and posterior pelvic rotation.

CONCLUSION: There is a dynamic relationship between the pelvis and the spine. Although not all changes in spinal parameters were statistically significant from resting to end-position, it is clear that spinal parameters change relative to pelvic position in normal individuals and these changes are measureable radiographically. A future study on the dynamic spino-pelvic relationship in patients with spinal disorders is warranted to determine clinical relevance, as similar findings could guide future treatment.

Biomechanical Analysis Comparing Construct Stiffness in Posterior Lumbar Fusion When Altering the Diameter or Type of Pedicle Screw, and Un-Cortical vs. Bi-Cortical Fixation

Abstract ID: Poster 066

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INTRODUCTION: Pedicle screw instrumentation is the gold standard for stabilization of the posterior lumbar spine. Despite its effectiveness, the constructs are still subject to hardware failure over time. Clinically, failure of the hardware more commonly occurs as a result of toggling at the bone-screw interface or breakage of the screw itself. The evolution of new percutaneous techniques has required the need for cannulated pedicle screws. We hypothesize constructs using cannulated screws would be less stiff than solid screws and therefore more prone to early hardware failure. To date, most biomechanical studies have focused on screw “pull out strength” as a measure of a construct’s strength and stability or measured the stiffness of a single pedicle screw. The aim of this study was to see if the inherent weakness of the cannulated screw construct could be overcome by either increasing the diameter of the screw or obtaining bi-cortical fixation; thereby decreasing the rate of early hardware failure.

METHODS: 24 Porcine specimens were divided into 4 groups and a single spinal unit was instrumented. The four groups included: I-6.5 mm solid screws, II-6.5 mm cannulated screws, III-7.5 mm cannulated screws, 6.5 mm cannulated screws with bi-cortical fixation. The stiffness of each construct was tested in the 6° of freedom (DoF) utilizing an Instron 8500 servo-hydraulic material-testing machine. Univariant analysis of variance was used to compare the stiffness in the 6 DoF among the four groups.

RESULTS: There did not appear to be a statistically significant difference among the any of the groups compared. 7.5 mm cannulated screws had an average stiffness of 1.142 Nm compared to 6.5 mm cannulated screws average stiffness of 1.128 Nm (p=0.876). Bi-cortical fixation had an average stiffness of 1.149 Nm compared to uni-cortical fixation average stiffness of 1.126 Nm. (p=0.781). Solid pedicle screws had an average stiffness of 1.143 Nm compared to cannulated screw average of 1.128 Nm (p=0.856).

CONCLUSION: Previous studies have demonstrated differences in the stiffness of single pedicle screws when varying the insertion depth and diameter of the screw. However, when taking into account the entire construct used in posterior fusion procedures there appears to be no difference in the stiffness when comparing pedicle screw type, diameter, or type of fixation.

TRAUMA

The Role of Osteoactivin in Bone Regeneration: A Sheep Model for Bone Healing

Abstract ID: Poster 067

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INTRODUCTION: The search for osteoinductive therapeutic compounds remains critical to help accelerate bone healing in many orthopedic surgeries. Autologous bone grafting is most commonly used for the treatment of these cases with over 2 million bone grafting procedures performed each year. However, despite this high frequency autologous bone grafting has many disadvantages and inherit morbidity secondary to surgical donor site pain, blood loss, hematoma formation, infection, injury to local structures, and longer operative times. Osteoactivin (OA) is an osteoinductive protein that has previously been shown by our group to stimulate osteoblast differentiation and function in vitro and bone regeneration in vivo in rats. In order to demonstrate therapeutic efficacy of OA in bone regeneration, a larger animal model with a bone healing rate comparable to humans is necessary to predict the effect of the compound in humans. Thus, the sheep model provides a way to study the effect of OA on osteogenesis by inducing critical size defects into the long bones of the animals.

METHODS: Bilateral hind limbs in six male sheep between ages 2-3 years old were used in this study. Once under appropriate anesthesia, one femur defect was drilled (11 mm diameter x 25 mm depth) and packed with an absorbable collagen sponge without OA protein and thus functioned as a control, while the other defect was filled with recombinant OA-soaked collagen sponge. The animals were terminated after a period of 10 weeks. The femurs were harvested for x-ray, µCT imaging, and histology. Tissue biopsies were taken from heart, lung, liver, spleen, kidney, thyroid gland, adrenal gland, and skeletal muscle for RNA and histological analyses during post-mortem dissection. CBC, CMP, and urinalysis were also analyzed.

RESULTS: Initial radiographic analysis indicated regeneration of bone at the defect site in both high-dose and low-dose treated sheep, while the control femurs showed no significant change in the size of the defect or significant bone regeneration. µCT analysis of control and OA-treated defects measured the bone volume and density of the regenerated area indicating an increase at the OA-treated defect sites. CBC, CMP, and urinalysis showed no apparent abnormalities between control and OA-treated sheep.

CONCLUSION: As a result of this study, it is evident that OA plays a role in bone regeneration following injury in a large animal model. This provides a proof of concept that OA can potentially be utilized as a therapeutic agent in humans to help in cases of bone regeneration.

Incidence, Risk Factors, and Clinical Implications of Pneumonia Following Surgery for Geriatric Hip Fracture

Abstract ID: Poster 068

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INTRODUCTION: The purpose of this study is to determine the incidence, risk factors, and clinical implications of pneumonia following surgery for geriatric hip fracture.

METHODS: The American College of Surgeons National Surgical Quality Improvement Program was used to conduct a retrospective cohort study of geriatric patients undergoing surgery for hip fracture. Independent risk factors for the development of pneumonia within 30 days of surgery were identified using multivariate regression. Mortality, sepsis, and readmission rates were compared between patients who did and did not develop pneumonia using multivariate regression that adjusted for all demographic, comorbidity, and procedural characteristics.

RESULTS: 29,377 patients met inclusion criteria. Of these, 13,736 underwent hemiarthroplasty, 1,299 total joint arthroplasty, 580 percutaneous fixation, 4,294 plate/screw fixation, and 9,468 intramedullary fixation. In total, 1,191 patients developed pneumonia, yielding an estimated incidence of 4.1% (95% confidence interval = 3.8-4.3%). Independent risk factors for pneumonia were older age, male sex, lower body mass index, chronic obstructive pulmonary disease, congestive heart failure, preoperative dyspnea on exertion, and preoperative anemia. Patients who developed pneumonia following discharge had a higher readmission rate (79.1% versus 8.2%, adjusted relative risk [RR]=8.7, 95% confidence interval [CI]=8.1-9.5, $p<0.001$) and a higher mortality rate (29.2% versus 5.7%, adjusted RR=3.7, 95% CI=3.3-4.1, $p<0.001$). Among 1,602 total mortalities, 348 (17.9%) occurred in patients who had developed pneumonia.

CONCLUSIONS: Pneumonia is a serious complication following geriatric hip fracture surgery that occurs in approximately 1 in 25 patients. Approximately 4 in 5 patients who develop pneumonia are subsequently readmitted, and approximately 1 in 3 die. Given the serious implications of this complication, evidence-based pneumonia prevention programs including oral hygiene with chlorhexidine, sitting upright for meals, elevation of the head of the bed to at least 30°, aggressive incentive spirometry, and early ambulation should be implemented for patients at greatest risk.

How Accurate is Intraoperative Fluoroscopy in Gauging Femoral Anteversion?

Abstract ID: Poster 069

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INTRODUCTION: Appropriate intraoperative imaging is paramount to create anatomic reconstruction of injured extremities. Fluoroscopic imaging of the distal femur has been nicely described in the literature and is easily reproducible in the operating room. Because of its version, the proximal femur can be difficult to image and it can be a challenge to reproduce native anteversion in comminuted femur fractures. The purpose of this study was to determine if fluoroscopy could be used to accurately assess femoral anteversion in the operating room setting.

HYPOTHESIS: Through the use of fluoroscopy, femoral anteversion can be accurately reproduced in the operative room setting when compared to CT scan.

MATERIALS AND METHODS: Ten synthetic femora were osteotomized in the middle 1/3 shaft. These were set to random amounts of version and held with lateral-based LCP plates/screws above and below the osteotomy site. CT scans of these specimens were then obtained and read by a MSK radiologist to determine the new version. A radiolucent jig was created to hold the specimens in a blinded fashion. A C-arm fluoroscopy unit was outfitted with a digital protractor to measure the angle of the C-arm relative to ground. Six orthopedic surgeons of varying levels of experience were asked to define femoral anteversion of the specimens. Measurements were taken at 90° and 45° angles relative to the specimens. Data was stratified to surgeon experience and the absolute value of the difference in angles from CT to intraoperative was measured.

RESULTS: The estimated version was not consistently different from the measured (CT data) when stratified by surgeon experience. On average, images taken at 45° angle were more accurate than those taken perpendicular to the operating table.

DISCUSSION: Restoration of anteversion in the lower extremity is important for normal gait patterns. The variability of our data indicates the difficulty of obtaining appropriate femoral anteversion using C-arm fluoroscopy. We anticipated that this variability would be inversely proportional to surgeon experience, but this was not the case. Further research is needed to develop a more accurate method of obtaining femoral anteversion in the operative room setting.

CONCLUSION: Despite the variability of our results, the average distance away from CT was still less than 10° for all data points. Using current methods of obtaining a true lateral of the proximal femur, intraoperative fluoroscopic imaging is still a relatively inaccurate method of measurement compared to CT.

Biomechanical Analysis of a Novel Technique Utilizing a Modified Anterior Supra-Acetabular Internal Fixator Traversing the Sacroiliac Joint

Abstract ID: Poster 070

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PURPOSE: We developed a new technique utilizing cannulated anterior supra-acetabular internal fixator (ASIF) screws being driven from just lateral to the anterior inferior iliac spine posteriorly through the sacroiliac joint and anchored into the S1 ala aiming towards the superior articular process. The purpose of this study was to biomechanically evaluate the stability and compressive forces of this new technique (RadZ technique) and compare it to established percutaneous methods of fixation in vertically unstable pelvic injuries.

METHODS: Four composite pelvises, with simulated anterior posterior compression type III injury, were each assembled with five constructs: an anterior plate with S1 sacroiliac (SI) screw, ASIF with SI screw, ASIF alone, combined ring construct, and our novel RadZ construct. Every construct was tested on each of the pelvises with compressive loading in a single-leg stance. Maximum load and displacement were measured at the pubic symphysis (PS) and SI joint, and axial stiffness was calculated. Values were compared using multiple one-way ANOVAs with Bonferroni correction.

RESULTS: The mean maximum load of our RadZ construct, the anterior plate with the SI screw, and ring construct were significantly greater than the ASIF with and without SI screw ($p < 0.05$). However, no difference was found between the anterior plate with the SI screw, ring, and RadZ constructs. With regards to SI joint stiffness, the RadZ construct, anterior plate with SI screw, and ring construct did not exhibit significant difference between each other ($p < 0.05$). PS joint stiffness with the RadZ technique, ASIF with SI screw and ring construct were significantly stiffer than the ASIF alone ($p < 0.05$). No difference was noted between the ASIF with SI screw, ring, and RadZ constructs for PS joint stiffness.

CONCLUSIONS: Instrumentation with an anterior plate and SI screw has long been the gold standard for vertically unstable pelvic fractures. The RadZ technique provides biomechanical equivalence for maximum loading and SI joint stiffness compared to anterior plating with SI screws. Although we found no significant difference in maximum load between the anterior plate with the SI screw, ring construct, and RadZ construct, the RadZ construct had an average maximum load nearly 23N greater than anterior plate with SI screw. Anterior plate proved to be the best option for PS joint stiffness, but in the incidence of a SI joint disruption with PS fracture, too severe for utilization of the plate the RadZ technique may be an alternative.

Hip Fractures: Appropriate Timing to Operative Intervention

Abstract ID: Poster 071

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INTRODUCTION: Fractures of the hip are common with delay of greater than 24 to 48 hours leading to increased morbidity, mortality, and decreased patient outcome measures. Knowledge of modifiable risk factors for surgical delay in the setting of hip fractures would allow surgeons to efficiently optimize patients prior to surgical intervention. Understanding of non-modifiable risk factors surgical delay would allow for comparison across different surgeons and healthcare systems. The purpose of this study was to utilize a large multicenter database to (1) identify the incidence of surgical delay in hip fractures, (2) evaluate the time point surgical delay puts patient at increased risk for complications, and (3) identify risk factors for surgical delay in the setting of surgical management of hip fractures.

METHODS: The American College of Surgeons NSQIP database was queried for patients of 60 years of age or older undergoing surgical treatment of a hip fracture between 2005 and 2010. In total, 4,696 patients who underwent either open or closed hip fracture fixation were identified using Current Procedural Terminology codes. Patients with a hip fracture treated with total hip arthroplasty were not included. Surgical delay was defined by days from admission until surgical intervention. Univariate analyses and subsequent multivariate analyses were performed.

RESULTS: Of 4,039 patients who met inclusion criteria, 3,166 patients (78.4%) experienced surgical delay of ≥1 day after hospital admission, 1,242 patients (30.8%) experienced delay ≥2 days, and 450 patients (11.1%) had a delay of ≥3 days. There was a significant difference in overall complications if patients experienced surgical delay of ≥2 days ($p \leq 0.01$); no difference in complications was seen with earlier surgical intervention. Multivariate analyses identified multiple risk factors for surgical delay ≥2 days including CHF (odds ratio [OR], 3.07; 95% Confidence Interval [CI], 2.03-4.64), ASA class 4 (OR, 2.45; 95% CI, 1.82-3.30), and hematocrit<38% (OR, 1.97; 95% CI, 1.63-2.38).

DISCUSSION AND CONCLUSION: Surgical delay of ≥2 days in the setting of hip fractures is common and confers an increased risk of postoperative complications. We recommend surgical intervention prior to 48 hours from hospital admission in an effort to minimize risk of postoperative complications. Surgeons can develop preoperative protocols to identify and treat patients with our identified modifiable risk factors in a timely fashion. Healthcare systems can utilize our non-modifiable risk factors when performing quality assessment and cost accounting in the setting of hip fracture care.

One vs. Two Screw Fixation for Medial Malleolus Fractures: Evaluation Using a More Realistic Biomechanical Model

Abstract ID: Poster 072

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INTRODUCTION: In supination-external rotation and pronation-external rotation ankle injuries, the medial malleolus usually sustains a fracture having a horizontal-oblique pattern. Typically, these are fixed with two parallel screws. Recently, however, single screw fixation has gained in popularity. Previous comparative biomechanical studies have excluded fracture fragment interdigitation, a clinical feature of these injuries, as part of their study designs. Nonetheless, it has a clinical role in reduction stability. Therefore, we designed a more clinically relevant model to study the biomechanical properties of one versus two-screw fixation of these horizontal-oblique medial malleolus fractures. We hypothesized that one-screw and two-screw fixation with a fracture interdigitation model will provide constructs that are not biomechanically significantly different.

METHODS: To create the fracture interdigitation model, identical 120° half-chevron osteotomies were performed on the medial malleolus in 30 4th generation composite polyurethane tibias using customized jig. For osteotomy fixation, another customized jig was used to create uniform 2.5 mm drill holes and allow identical screw insertion in each model. Specimens were divided into two groups: 15 fixed with one screw and 15 with two parallel screws. Drilled holes were made directly between the anterior and posterior colliculus (one-screw model) or in each colliculus (two-screw model). All screws were partially threaded, 35 mm long, 4.0 cancellous screws and all were tightened to 10 inch-pounds of torque. Next, using a Material Testing System, the constructs were loaded to failure. A stress-strain curve was created for each model, and peak load and offset failure loads were obtained. Statistical analyses were performed using a t-test and a Mann-Whitney U, as appropriate.

RESULTS: Median peak force measured in Newtons (N) for the one-screw model was 177.70, and median peak force for the two-screw model was 390.52 N ($p<0.001$). Median offset failure load for the one screw model was 89.66 N and median offset failure load for the two screw model was 154.05 N ($p<0.001$). All constructs failed in shear, displacing axially, with little to no rotation.

CONCLUSION: The failure mode indicates the half-chevron osteotomy approximates interdigitation fracture patterns found in clinical settings. Using this more clinically relevant interdigitation model, peak force and failure loads of the parallel two-screw configuration were significantly greater than those of the one-screw group. Therefore, it is apparent a two-screw construct is more stable than one-screw fixation for fractures of the medial malleolus, and single screw fixation is not recommended.

Static vs. Dynamic External Fixation for Persistent Instability After Elbow Fracture-Dislocation

Abstract ID: Poster 073

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INTRODUCTION: The outcomes of static versus dynamic external fixation for persistent instability after elbow fracture-dislocation injuries has not been reported. Benefits of static external fixation may include shorter operative times and less pin-site related issues; however, it may be complicated by higher rates of stiffness.

METHODS: A retrospective review was performed identifying five patients who were treated with static external fixation and five patients treated with dynamic external fixation for persistent instability after elbow fracture-dislocations. Four patients in the static group and three patients in the dynamic group had previous operations to address instability. At the time of external fixator placement, four patients in each group underwent additional procedures for stability. Data collected included complications, additional surgeries, and range of motion at the time of fixator removal and last follow-up.

RESULTS: The static and dynamic fixator groups had similar average (±SD) age (63±9 vs. 57±14 years, p=0.4), follow-up time (18±7 vs. 16±7 months), time from injury to external fixation (32±32 vs. 26±22 days, p=0.7), and time until external fixation removal (42±5 vs. 38±11 days, p=0.5). After fixator removal, there was no difference in elbow extension (31±9° vs. 39±7°, p=0.1) and flexion (128±9° vs. 117±9°, p=0.3). At last follow-up, there was no difference in elbow extension (34±8° vs. 27±12°, p=0.3), flexion (129±20° vs. 123±9°, p=0.5), pronation (67±12°vs. 76±12°, p=0.6), and supination (56±28° vs. 50±27°, p=0.7). One patient in the dynamic external fixator group had a subsequent procedure for stiffness associated with extensive heterotopic ossification. There were no pin site infections requiring intervention in either group.

CONCLUSION: Static and dynamic external fixators for persistent instability after elbow fracture-dislocations had equivalent outcomes. Static external fixation is less expensive, takes less time, and is not complicated by higher degrees of stiffness.

INFIX vs. Plating for Pelvic Fractures with Pubis Symphysis Diastasis

Abstract ID: Poster 074

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BACKGROUND/PURPOSE: Unstable pelvic injuries with symphysis pubis(SP) disruption are traditionally fixed with plating. INFIX is a biomechanically sound method of fixation. We compare INFIX to symphyseal plating, assessing reductions, complications, and functional outcomes.

METHODS: A retrospective study was performed using our trauma database, including 52 patients. Twenty-four patients undergoing INFIX application with posterior fixation were compared to 28 patients with SP plating and posterior fixation.

INFIX: There were 13 B and 11 C-type AO/OTA injuries. We saw 13 (54%) APC, 7 (29%) VS, and 4 (17%) LC fractures. The average age of patients was 43.38 years (21-86), 18 males, 6 females with an average ISS of 21.53 ± 8.71. The average length of follow-up was 40.44 months (13-80).

PLATES: There were 14 B and 14 C type AO/OTA injuries. We saw 17 (61%) APC type, 7 (25%) LC type, and 4 (14%) VS fractures. The average age of patients was 39.6 years (21-62), 25 males, 3 females with an average ISS of 22.48 ± 8.45. The average length of follow-up was 83.48 months (28-132).

Reductions of the SP were measured using AP pelvis x-rays. Pelvic ring reduction was measured using the Keshishyan Cross-method and reported as the pelvic deformity index (PDI). Functional outcomes were assessed using the Majeed score. Complications were recorded.

RESULTS: INFIX: Average SP reduction was 63.48% (19.70-85.09%). Average pelvic ring reduction was 14.96% using the PDI. Five (21%) patients developed complications. Two (8%) improper implantations, 1 (4%) case of pain associated with the device, 1 (4%) irritation to the lateral femoral cutaneous nerve, and 1 (4%) surgical site infection. The improper implantations occurred in the early cases and were improper fixation of the screw-caps resulting in loss of reduction and in 1 case the construct was placed too deep requiring revision. Eleven cases of HO (52.38%) were seen in our patients with no sequelae. The average Majeed score was 84 (median 89, range 51-100).

PLATES: The SP reduction was 75.25% (9.68-90.00%). Average pelvic ring reduction was 54.15% using the PDI. Complications included 4(14%) surgical site infections and 3 (11%) implant failures. We saw 1 broken plate and 2 cases of screw loosening. The average Majeed score was 73.77 (median 79, range 48-100).

CONCLUSIONS: Plates provide superior reduction of the SP (p=0.036). Plating requires only one surgery, INFIX requires 2. Complication rates were similar (p=0.37). There was no

difference in the Majeed scores (p=0.0774). INFIX may be preferred in obese patients due to ease of application and in young women as there is no retained implant.

Five to Ten Year Outcomes of Operatively Treated Scapula Fractures

Abstract ID: Poster 075

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BACKGROUND/PURPOSE: Recent series of patients with displaced scapula fractures have been shown to have good range of motion (ROM), strength, and functional outcomes following surgical fixation. The majority of nonoperative scapula outcomes studies consist of small retrospective series that include heterogeneous fracture types and no record of displacement. There is only one study of 68 patients that reports outcomes at a minimum of 5 years from nonoperative treatment, which suggested residual scapular deformity is associated with more clinical symptoms (Nordqvist and Petersson, CORR 1992). The purpose of this study is to report 5-10 year functional outcomes after ORIF of both intra and extra-articular scapula fractures.

METHODS: Between 2005 and 2010, the senior author operated on 106 patients with scapula fractures, of which 60 (57%) were referred for treatment. Only 9% of patients presenting to our trauma unit with a scapula fracture met operative indications. Patients were prospectively enrolled into an operative registry. Medical records were reviewed to report complications and subsequent procedures. Patients returned 5-10 years postoperatively to record ROM, strength, return-to-work status, and a DASH form. The uninjured shoulder served as an internal control for ROM and strength testing. Sixty patients either returned to clinic for examination (56) or completed mailed DASH forms (4). Patients with intra-articular fractures were analyzed separately from extra-articular fractures. Isolated process fractures were excluded.

RESULTS: There were 28 intra-articular and 32 purely extra-articular body/neck fractures. Mean follow-up was 7.4 years (range = 5 - 10). Mean age was 49 years. The only perioperative complication was an intra-articular screw which was exchanged 3 days postoperative. In the intra-articular group, mean DASH score was 9.4 (normative mean = 10.1). Two patients required subsequent shoulder arthroplasty, 3 underwent removal of superficial implants (ROH), and 4 underwent manipulation of the shoulder (MUA) during rehab for stiffness. There were 7 suprascapular and 3 axillary nerve injuries. In the extra-articular group, mean DASH score was 9.1. Four patients had ROH, and 3 had MUA for stiffness. There were 3 suprascapular nerve injuries. A paired t-test revealed small but significant differences between the injured and uninjured shoulders in all ROM and strength measurements ($p < 0.05$) for both groups. Following surgery, 51/60 (85%) reported returning to a similar prior occupation.

CONCLUSIONS: Mid-term outcomes of operatively treated scapula fractures reveal a small yet significant difference in shoulder ROM and strength compared to the uninjured shoulder; however, DASH functional outcomes scores were normal.

Variability in Operative Time and Cost of Irrigation Methods

Abstract ID: Poster 076

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PURPOSE: A recent international, multicenter, blinded, randomized study evaluating the effectiveness of various irrigation methods involved in the initial management of open fractures found no difference in reoperation rates or postoperative infection regardless of irrigation pressure. The purpose of this study was to compare the time and costs associated with these irrigation methods to determine which is most cost and time effective.

METHODS: Non-clinical timed trials of irrigation according to the specifications of the recent randomized blinded study by The FLOW Investigators. Actual direct costs of each irrigation method were obtained and indirect costs were calculated based on time-dependent operating room costs at a single tertiary care center.

RESULTS: The average time to complete three liters of normal saline irrigation at very low pressure was 104 seconds. This was significantly faster than low pressure (205 seconds, p=<0.001) and high pressure (168 seconds, p=0.0048). This difference increased with more irrigation as very low pressure irrigation times remained constant while low and high pressure irrigation times slowed with subsequent irrigation. Direct and indirect costs also varied among irrigation methods as well. At this institution, use of very low pressure irrigation would save $43 in direct costs with approximate indirect cost savings ranging from $50 to $260 per operative open fracture case.

CONCLUSION: Very low pressure irrigation resulted in significantly faster irrigation times at significantly lower direct and indirect costs. Recent literature does not support any difference in reoperation rates among irrigation methods, but very low flow irrigation can provide logistical and economical benefits. There are approximately 250,000 open fractures in North America annually and with a savings of $94 to $303 per surgery, dramatic systemic savings could be achieved.

Should We Throw Away the External Fixator for Knee Dislocations?

Abstract ID: Poster 077

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PURPOSE: Knee dislocations are limb-threatening injuries. There is limited outcome data to guide optimal management strategies of the multiligament-injured knee. There are currently no articles in the literature that describe the patient reported outcomes of multi-ligamentous knee dislocations treated with non-articulated external fixation. The purpose of this study is: (1) to describe the demographic and injury characteristics of a series of patients with multi-ligamentous knee dislocations and (2) to report patient outcome data (SANE and PROMIS scores) following the use of non-articulated external fixation.

METHODS: Between 2008 and 2013, 41 patients with multi-ligamentous knee dislocations presented to our emergency department. Their medical records were retrospectively reviewed for injury characteristics and patient demographics. Minimum follow-up of 9 months was required for eligibility. All patients underwent manipulation under anesthesia at time of removal of external fixation. Patient-reported outcome data was quantified using SANE (Single Assessment Numeric Evaluation) and PROMIS (Patient Reported Outcome Measurement System) scores.

RESULTS: 33 patients with minimum follow-up of 9 months were identified. The mean age was 39 and a mean BMI was 32. The most common mechanism for injury was Motor Vehicle Collision (42%). All injuries were multiligamentous knee injuries. 82% of patients were treated definitively with external fixation, while 18% underwent ligamentous repair/reconstruction. The mean time to removal of external fixation was 48 days . 86% of patients underwent formal physical therapy. The mean Range of Motion of the knee was 101° (range 55-138°). The patient reported outcomes were obtained using SANE and PROMIS scores, with a mean SANE score of 49 (range 5-90) and mean PROMIS score of 38 (range 32-46).

CONCLUSION: To our knowledge, this series represents the first dedicated patient reported outcome data using SANE and PROMIS scores in patients sustaining multi-ligamentous knee injuries treated with non-articulated external fixation. While use of this method might be thought of as leading to stiff knee, the patient's final range of motion in this study is higher than previous reports. Our protocol of manipulation under anesthesia at the time of external fixator removal and importance of outpatient physical therapy most likely contributed to these results. Multiligamentous knee dislocations are serious injuries as the overall patient reported outcomes were poor. Further multi-centered studies are necessary to elucidate which factors predispose to poor outcomes.

Higher Incidence of Surgical Site Infection with Plate Fixation Compared to Intramedullary Nail Fixation of Distal Femur Fractures

Abstract ID: Poster 078

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Prior investigations of distal femur fractures have supported efficacy of plate fixation (PF) and retrograde intramedullary nailing (RIMN). The purpose of this study was to determine risk factors for postoperative complication leading to early reoperation in DFF. We hypothesized that postoperative complications would be similar between RMIN and PF of DFF. We conducted retrospective analysis of operatively treated distal femur fractures at single Level 1 academic trauma center from 2013-2015. AO/OTA fracture classification of 33A or 33C and Lewis and Rorabeck type I or II or fractures with ipsilateral total hip arthroplasty were included. Outcomes were assigned based on chart review. Patients lost to follow-up before documentation of healed fracture, nonunion, or unplanned reoperation were contacted by phone to determine their clinical course since last follow-up. Unreachable patients were excluded. Postoperative complication was defined as unplanned reoperation. Patient and injury characteristic data were collected to ensure similarity between compared groups. We identified 98 patients who met inclusion criteria. Nineteen patients were excluded due to inadequate follow-up, leaving 79 patients for analysis. There were 53 patients with RIMN and 26 with PF. There were 14 patients with unplanned reoperation including five surgical site infections (SSI), and 9 aseptic nonunions. All 5 SSI occurred in the PF group (p=0.003). Median patient age in the RIMN group was 62.1 years old (range, 20.1-95.1) and was 73.9 years old in the PF group (range, 19.2-94.0) (p=0.012). Median procedure time in the RIMN group was 104 minutes (range, 43-368) and in the PF group was 117 minutes (range, 68-356), p=0.05. Despite these differences between the PF and RIMN groups, neither age nor operative time were predictive for SSI (p=0.825 and 0.134, respectively). The reasons for the significantly increased risk of SSI with PF versus RIMN are not clear based on the retrospective nature of our study; however, possible contributors may be increased soft tissue trauma from dissection with exposure for PF relative to RIMN or other possible confounding factors that we did not consider. The statistically significant lower median operative time with RIMN of 13 minutes is likely not clinically significant. The statistically significant higher median age of patients with PF is likely related to patients with THA and other previously placed intramedullary implants generally being treated with PF instead of RIMN; these patients tend to be older than patients with no previous surgeries.

Incidence of Ankle Fusion After Pilon Fracture

Abstract ID: Poster 079

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INTRODUCTION: Pilon fractures are severe injuries to the ankle with relatively high incidence of complications that can lead to morbidity. The purpose of this study was to determine the effects of key variables on the likelihood of arthrodesis in patients with pilon fractures.

METHODS: Patients with pilon fractures treated at a rural academic ACS level 1 trauma center by three fellowship-trained orthopedic trauma surgeons from 2005-2014 were retrospectively reviewed. Medical records and radiographs were reviewed for patient demographics, co-morbidities, pre-injury arthritis, injury characteristics, associated injuries, mechanism of injury and functional activity. Current functional level was gathered by calling participants. Proportions for each patient variable were determined and Fishers Exact or chi-square tests were used to assess for significant ($p<0.05$) differences for each variable. When proportions were significantly different, odds ratio was calculated.

RESULTS: 306 patients met inclusion criteria. Mean patient age at time of surgery was 43.8 +/- 15.4. No statistically significant differences in likelihood of arthrodesis were found with respect to patient age <65, tobacco use, fracture type, or open fracture status. Diabetics were significantly ($p=0.001$) and 5 times more likely to have arthrodesis. The need for additional surgeries was significantly ($p<0.0001$) and 11 times more likely to be associated with arthrodesis.

CONCLUSIONS: Out of all of the possible risk factors, diabetic patients and those requiring additional surgeries beyond the initial pilon fracture surgeries had a significantly higher risk for arthrodesis. Surgeons may use this information to communicate these risks to their pilon fracture patients.

Age and Dressing Type as Independent Predictors of Postoperative Infection in Patients with Acute Compartment Syndrome of the Lower Leg

Abstract ID: Poster 080

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PURPOSE: Acute compartment syndrome (ACS) constitutes an orthopedic emergency. Upon diagnosis of ACS, there is consensus that fasciotomy should be performed emergently. In patients undergoing delayed fasciotomy, it is unclear whether the benefits of fasciotomy are offset by the increased potential risk for postoperative infection. The purpose of this study was to determine independent factors associated with increased risk of postoperative infection in patients presenting with ACS of the lower leg, with particular emphasis on timing of fasciotomy.

METHODS: A series of 70 adult patients with ACS of the lower leg treated with fasciotomy were retrospectively identified. Demographic data including age, comorbidities, injury type, fasciotomy method, postoperative dressing type, need for skin grafting or flap, intraoperative findings, and incidence of postoperative infection were collected. Time of injury was determined from EMS and ED records and time of fasciotomy from operative reports. Patients with incomplete medical records were excluded from analysis. A total of 53 patients comprised the final study cohort.

RESULTS: Surgical site infection occurred in 16 of 53 (30.2%) patients postoperatively. Compared to patients with infection-free outcome, patients with postoperative infection had higher median age (52.0 vs. 37.0 years, $p = 0.010$), prevalence of myonecrosis at time of fasciotomy (31.2% vs. 5.4%, $p = 0.021$), and use of vacuum-assisted closure (VAC) devices (93.7% vs. 45.9%, $p = 0.002$). Median time from initial injury to fasciotomy or from initial injury to skin graft coverage did not vary significantly between patients with and without postoperative infection (8.8 vs. 11.2 hours, $p = 0.427$ and 7.0 vs. 5.0 days, $p = 0.121$, respectively). Multivariate logistic regression analysis indicated that use of VAC devices (odds ratio, [OR], 17.10; 95% confidence interval [CI], 1.78 – 164.0; $p = 0.014$) and increasing age (OR, 1.07; 95% CI, 1.01 – 1.14; $p = 0.037$) were independent predictors of postoperative infection. Fasciotomy performed within 8 hours, 8-24 hours, or after 24 hours following time of initial injury was not, independent of other factors, related to the risk of postoperative infection.

CONCLUSION: Acute compartment syndrome represents a spectrum of injury severity which can evolve over variable lengths of time. In this series, postoperative infection following fasciotomy for ACS of the lower leg was associated with increased age and use of VAC devices. While emergent fasciotomy is recommended once the diagnosis of ACS is made, it appears that delayed fasciotomy was not associated with an increased risk of postoperative infection.

Are You In or Are You Out? Detecting Cortical Breaches of the Femoral Neck During Cannulated Screw Insertion

Abstract ID: Poster 081

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INTRODUCTION: Percutaneous cannulated in situ screw fixation remains a viable option in the treatment of nondisplaced and valgus impacted femoral neck fractures. The posterior-superior screw may run an “in-out-in” configuration which may weaken the construct, affect stability, and violate the vascular supply to the femoral head. The objective of this study was to assess the ability to recognize a malpositioned screw.

METHODS: 11 adult-sized femoral saw bones were used with a cannulated screw guide pin randomly inserted. Five anteroposterior (AP) and 5 lateral fluoroscopy was performed at 10° intervals with images distributed to attending traumatologists and residents at our institution in a blinded fashion. Five samples were “all-in” and 6 were “in-out-in.” Accuracy and interobserver reliability was assessed.

RESULTS: Overall interobserver reliability was substantial with $\kappa = 0.70$. The accuracy was 87.2% among attending surgeons and 85.5% among residents ($p = 0.50$). The sensitivity and specificity for an “in-out-in” orientation was 98.0% and 71.2%, respectively.

DISCUSSION: The clinical significance of an “in-out-in” screw is yet to be determined. This study demonstrates the ability of a surgeon to identify all screws with an “in-out-in” trajectory using intraoperative biplanar fluoroscopy over a 50° arc. Based on review of the imaging, it is our belief that the absence of a cortex outside the pin is indicative of a suboptimal pin position. Further clinical studies to evaluate the significance and outcomes of an “in-out-in” trajectory are indicated.

A Biomechanical Study of a New Subcutaneous Locked Plating Technique for Comminuted Distal Radius Fractures

Abstract ID: Poster 082

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INTRODUCTION: External fixators that span the wrist have been the historical norm in highly comminuted distal radius fractures. We modified the Burke approach by using a subcutaneously applied locked bridge plate. It can allow for motion of the fingers and easier application and removal through 2 small incisions superficial to the extensor tendons and outside the extensor compartment. The purpose of this study was to biomechanically evaluate this modified method of fixation for comminuted distal radius fractures in comparison with two established constructs.

METHODS: Three constructs were tested. Our modified construct consisted of a 14 hole 3.5 locking plate fixed on the dorsal aspect of the forearm, from the radius to the second metacarpal subcutaneously, with 6 locking screws (N=3) sitting off the bone 15 mm. The Burke plate consisted of a 3.5 plate fixed conventionally on the dorsal surface of the bone using 6 non-locking cortical screws (N=3) and a standard external fixator device (EXFIX; N=3). All constructs were tested using matched pairs of fresh frozen cadaver forearms. A 1 cm defect in the distal radius simulated a badly comminuted distal radius fracture. Specimens were potted using PMMA proximally, fixed to a custom made fixture and tested on a materials testing machine. Axial compressive loading, cantilever bending in volar-dorsal, dorsal-volar and radial-ulnar directions, and torsion were tested. Stiffness was tested after loading with 50N. Specimens were re-tested for stiffness after undergoing 3000 cycles of cyclic loading axially to 50N.

RESULTS: In terms of axial stiffness, the modified construct was found to be stiffer than the EXFIX, before and after load cycling ($p=0.013$ for both). When compared to the Burke plate, the modified construct was significantly less stiff before axial cycling ($p=0.025$), however, the difference was not maintained after cycling; the post-axial loading stiffness difference was non-significant ($p=0.456$). A representative sample demonstrates post cyclic loading axial stiffness values of 234.08 N/m for our construct, 368.59 N/m for the Burke plate, and 55.82 N/m for the EXFIX.

CONCLUSIONS: Our data demonstrate the biomechanical integrity of our novel construct for the fixation of comminuted distal radius fractures. Our modified Burke construct is stiffer than the EXFIX. Additionally, it avoids pin-tract infections and is less cumbersome. While not as stiff as the Burke plate, our construct is minimally invasive, easier to remove, and does not violate the dorsal extensor compartments allowing movement of the fingers while the construct is in place.

Lower Extremity Non-Tensioned Traction Pins: Is it a Benign Procedure?

Abstract ID: Poster 083

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Balanced skeletal traction is used in damage control orthopedics to stabilize pelvic and femur fractures awaiting surgery. Traditionally, tensioned wires pins are placed in the femur or tibia to accomplish fixation for application of the distraction force. Recent studies demonstrated low complication rates with smooth 5/64" wires tensioned with a distraction bow. When using non-tensioned pins, higher rates of complications have been reported. We have used 6 mm centrally threaded non-tensioned pins, which do not require the use of a traction bow to achieve traction fixation. We sought to evaluate the clinical outcomes, as well as short-term complications, and long-term follow-up of these patients that have undergone large pin traction treatment.

HYPOTHESIS:
1. 6 mm centrally threaded pins would have a low incidence of pin tract infections.
2. Eccentric or improper location of the traction pins will have negative effects on patient outcomes.

Operative femoral, pelvic-acetabular fractures were queried over a five-year period. Patients without traction pins were excluded. Traction patients were evaluated for medical co-morbidities associated with infections. Lateral traction pin images were reviewed and tibial and femoral pin locations were designated based on a quadrant system. The diaphysis was bisected to determine anterior and posterior margins. Quadrant locations were (1- proximal anterior, 2- proximal posterior, 3- distal anterior, and 4- distal posterior). Analysis was performed to determine correlation between variables and presence of pin tract infection or other complications.

There were 556 patients, 360 male and 196 female, with an average age of 43.81. 258 were injured in a motor vehicle collision 157 had a fall, 47 sustained a gun shot wound, and 44 were in a motorcycle crash, 25 were involved in an auto versus pedestrian. There were 297 tibial, 226 femoral, 14 calcaneal, and 19 bilateral pins placed. The total pins placed were 575 pins: 320 tibial, 236 femoral, and 19 calcaneal. There was an average of 9.6 months of follow-up. There were 5 pin tract infections (0.87%) all of which were treated successfully with oral antibiotics. There were 17 foot drops (2.96%), 15 of which were prior to traction pin placement. There was no septic arthritis of the knee. There was no correlation between diabetes, BMI, smoking, HTN, and pin traction infections or foot drop. There were 283 pins place into zone 1, 166 in zone 2, 87 in zone 3, and 20 in zone 4. There was no correlation between femoral or tibial traction pins and pin traction infections. Of the 5 pin traction infections, all were placed in an eccentric posterior location, 4 were in zone 2 and 1 in zone 4, which was statistically significant ($p<0.05$).

We found a low infection rate with 6 mm centrally threaded traction pins in our population. These larger temporary lower extremity traction pins can be safely placed at the bedside and require no additional equipment for their use. We found that proximal and posterior placed pins have a correlation to pin tract infections and thus should be avoided. These posteriorly placed pins tether more musculotendonous structures and thus at risk for producing more immediate

tissue necrosis with insertion and or use. Non tensioned anterior pins can be used with risk of complication and are recommended.

Factors Predicting Admission to Extended Care Facility Following Distal Femur Fractures

Abstract ID: Poster 084

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BACKGROUND: Delayed identification of patients requiring admission to an extended care facility (ECF) following traumatic orthopedic injuries is leading to nonmedical delays in discharge, and unnecessary use of patient care resources and healthcare expenses. Arthroplasty and hip fracture literature has attempted to identify patient factors that can predict which patients may require discharge to an ECF. Currently, the literature is lacking in studies applying this same principle in other traumatic orthopedic injuries. The aim of this study is to identify patient factors that reliably predict the need for admission to an ECF following distal femoral fractures.

METHODS: A retrospective chart review was performed on patients admitted to the orthopedic trauma service at a single urban trauma center. Patients with a diagnosis of distal femoral fracture between the years of 2011-2014 were included in the study. A total of 176 patient charts were reviewed. Patient characteristics, demographics, medical comorbidities, and fracture classification were among the variables analyzed. Discriminate function analysis was used to determine a linear function of clinical values that can be used to predict whether a patient with a distal femur fracture is likely to need to be sent to an ECF following their hospital stay.

RESULTS: 71 patients, 23 men and 48 women, were included in the final statistical analysis. Of these patients, 11 men (48%) and 40 women (83%) were discharged to an ECF following their hospital stay. Discriminant function analysis of the data for men and women demonstrated that a higher ASA score ($p<0.001$), higher BMI ($p<0.02$), the presence of diabetes ($p<0.03$), and periprosthetic fractures ($p<.04$) for men, while a higher ASA score ($p<0.001$) and a lower admission hemoglobin value ($p<0.05$) for women were the most important variables in the predictive model for discharge to an ECF. Using the discriminate function analysis and a leave-one-out validation we were able to develop a predictive equation that correctly classified 95.7% of men and 81.3% of women as requiring discharge to an ECF.

CONCLUSIONS: We were able to identify patient factors that predicted discharge to an ECF. By using the predictive equation, we were able to correctly identify the vast majority of patients that required discharge to an ECF. Using this equation, patient care providers may be able to identify which patients will require ECF admission early in the hospital stay. This will enable earlier discharge planning and lead to decreased nonmedical discharge delays.

FOOT AND ANKLE

Two Repair Techniques for Achilles Tendon Ruptures with a Short Distal Stump: A Biomechanical Comparison

Abstract ID: Poster 085

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BACKGROUND: Chronic non-insertional Achilles tendinosis can result in an acute Achilles tendon rupture with a short distal stump. In such tendon ruptures, there is a limited amount of adequate tissue that can hold suture, thus presenting a challenge for surgeons who elect to treat the rupture operatively. Adding suture anchors to the construct may result in biomechanically stronger compared to a suture only technique.

METHODS: Nine paired Achilles-calcaneus complexes were harvested from cadavers. An artificial Achilles rupture was created 2 cm proximal to the insertion on the calcaneus. One specimen from each cadaver was assigned to a suture only or a suture anchor augmented repair. The contralateral specimen of the same cadaver received the opposing repair. Cyclic testing was then performed at 10 to 100 N for 2000 cycles. Load to failure testing was then performed at 0.2 mm/sec. This was followed by analysis of repair displacement, gapping at repair site, peak load to failure, and failure mode.

RESULTS: The suture anchor augmented repair exhibited a 116% lower displacement compared to the suture only repair (mean ± SD, 1.54 ± 1.13 mm vs. 3.33 ± 1.47 mm, respectively; $P < .03$). The suture anchor augmented repair also exhibited a 45% greater load to failure compared to the suture only repair (mean ± SD, 303.50 ± 102.81 N vs. 209.09 ± 48.12 N, respectively; $P < .04$).

CONCLUSION: Suture anchor augmented repairs performed on acute Achilles tendon ruptures with a short distal stump are biomechanically stronger than suture only repairs.

Revision Fusion Rate of Nonunion in Tarsometatarsal Arthrodesis in the Modified Lapidus Procedure and Flatfoot Reconstruction

Abstract ID: Poster 086

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BACKGROUND: Midfoot arthrodesis is indicated in patients with painful midfoot arthritis or instability who have failed a trial of conservative treatment. The etiology of midfoot arthritis is multifactorial; however, the majority of cases are post-traumatic or secondary to altered mechanics at the tarsometatarsal (TMT) joints.

Midfoot arthrodesis is successful both clinically and radiographically in greater than 90% of patients in modern series. Certain patients, however, will fail to progress to solid fusion. These patients typically present with swelling, pain with weight bearing, and altered gait.

To our knowledge, no study in the literature has addressed the management of failed midfoot arthrodesis. We propose a retrospective review of these patients at a single, tertiary referral foot and ankle practice to identify risk factors and examine outcomes for patients undergoing revision of failed midfoot fusion.

METHODS: Patients who received revision of 1st TMT fusion from 2008-2015 were identified via retrospective chart review. A 12-month follow-up was required for each case. After applying this criteria, our sample size narrowed to 2600 total patients. Of these patients, 35 patients were identified that met the criteria for a failed midfoot arthrodesis that required revision. These patients were matched to control patients, who received midfoot arthrodesis without revision, in a 2:1 fashion, based on date of procedure and surgeon performing operation.

The primary study end point examined was union rate following revision midfoot arthrodesis. Secondary objectives were to identify risk factors for failed midfoot arthrodesis, to assess the pain relief following treatment via AOFAS and VAS scores and to assess the rate of complications including infection, hardware failure, persistent pain and to assess radiographic healing.

RESULTS: 33/35 of the patients receiving revision surgery showed radiographic evidence of union. Significant differences in age and BMI were demonstrated between cases and controls. Patients who received revision of midfoot fusion demonstrated significant improvement in AOFAS score on average from 40.03 to 73.34 and average VAS score from 6.70 to 3.86. The improvement in VAS score was not as robust in cases in comparison to controls; however, there was no statistically significant difference observed in preoperative and postoperative functional improvement by AOFAS scores between the two groups.

CONCLUSIONS: Revision 1st TMT fusion yields improved functional outcomes and an

acceptable rate of fusion. These findings support the use of revision surgery as a viable option in the treatment of patients who develop nonunion after primary 1st TMT fusion.

Long-Term Outcomes Following Syme's Amputation

Abstract ID: Poster 087

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Syme's amputation is a rarely used end bearing amputation technique that requires little, if any, rehabilitation. Prosthetic fitting is relatively straightforward, as patients are allowed to end bear as soon as the amputation wound is secure. Surrounded by opinion and controversy, there is a paucity of objective information on the long-term outcomes of such patients.

Over a 13-year period, 50 patients were identified who underwent single stage Syme's ankle disarticulation amputation by a single surgeon. All patients underwent Syme's ankle disarticulation amputation with removal of the lateral and medial malleoli. None of these patients had sufficient tissue to allow amputation at the transmetatarsal or tarsal-metatarsal levels Following IRB approval, a retrospective chart review was performed and demographic information, indication for procedure, age at procedure, additional procedures performed and, if date of death, if applicable, recorded. Patients who were alive and could be contacted were invited to complete a modified, short musculoskeltal functional assessment (SMFA) questionnaire that was scored for functional, mobility, and bothersome indices.

Thirty-three underwent surgery due to diabetic forefoot infection, ten secondary to crush injury, three for non-diabetic infection, three for non-correctable acquired deformity, and one for neoplasm. The average age at surgery for the diabetic patients was 62.1 (range 36-81) years, with a follow-up of 6.8 (4-11.6) years. The non-diabetic patients averaged 38.1 (range 21-65) years, with a follow-up of 8.1 (range 2.2-13.8) years. Seventeen of the 33 diabetics had died. Four (12.1%) were converted to the transtibial amputation level. One of the non-diabetics had died and one (5.9%) was converted to the transtibial amputation level. Ten of the 32 patients who were contacted completed the modified SMFA. All of these patients demonstrated favorable outcome scores in the mobility, functional, and bothersome indices (non-diabetic mean mobility score of 19.4, functional index of 17.1 and bothersome of index of 20.3 compared to 34.7, 29.9 and 30.6 in the diabetic patients, respectively).

The objective information derived from this investigation supports the opinion that patients with Syme's ankle disarticulation amputation fare better than similar patients with transtibial amputation. This data also refutes the notion of high complication rates and difficulties with prosthetic fitting. These patients require less rehabilitation and achieve improved levels of functional independence as demonstrated by favorable functional, mobility, and bothersome indices.

Headless Compression Screw Fixation of Jones Fractures: A Clinical and Radiographic Comparison Study

Abstract ID: Poster 088

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INTRODUCTION: There remains controversy over the ideal implant for intramedullary screw fixation of fifth metatarsal Jones fractures. The purpose of this study was to compare clinical and radiographic results of Jones fracture patients treated with indication-specific partially threaded screws to variable-pitched headless compression screws. We also evaluated the association of patient and fracture characteristics with surgical failure.

METHODS: We performed a retrospective review and comparative analyses of all Jones fractures treated with primary intramedullary screw fixation by 4 foot and ankle fellowship-trained orthopedic surgeons at a single institution from 1995 through 2015. Exclusion criteria included concomitant foot/ankle procedures and revision surgery. Charts were reviewed for patient and injury characteristics, implant, and postoperative course. Radiographs were examined for fracture classification (Torg and anatomic zone) and radiographic union. Primary endpoint was number of surgical failures, defined as delayed union, nonunion, or refracture. Secondary endpoints included time to each of radiographic union, weight bearing, and pain resolution. Data were analyzed using independent T test, one-way ANOVA, chi-square, and correlation analyses with significance defined as $p<0.05$.

RESULTS: Fifty-nine feet were reviewed with mean age 30 years and follow-up 9.6 months. Forty-seven received a partially threaded screw (PT) and 12 feet a headless compression screw (HC). The PT group had more failures (10/47, 21.3% vs. 1/12, 8.3%; $p=0.31$) and more weeks to full weight (4.2 vs. 3.3, $p=0.06$), without significant differences in time to radiographic union or pain resolution. Most failures were delayed unions. Pooled union rate was 96.6%.

Correlated with failure were age ($r=0.469$, $p<0.001$), diabetes ($r=0.390$, $p=0.002$), and BMI ($r=0.281$, $p=0.03$), without significant correlation for tobacco, gender, or weight.

Compared to Torg 1 and 2, Torg 3 fractures had greater time to pain resolution and union, age, weight, and BMI. No differences were found between zone II and III fractures.

CONCLUSIONS: To our knowledge, this is the first reported clinical comparison between indication-specific partially threaded screws (PT) and headless compression screws (HC) for treating Jones fractures. This is also one of the largest clinical series on the subject. The two groups had similar clinical and radiographic results, both with high union rates. While most failures were delayed unions that ultimately healed, the 21% failure rate in the PT group is concerning and may warrant further investigation. Increasing patient age, diabetes, and BMI were associated with worse outcomes. These data support headless compression screw fixation as a viable treatment for Jones fractures.

The Effect of HgbA1C On Acute Postoperative Ankle Arthrodesis Infections and Overall Complications

Abstract ID: Poster 089

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INTRODUCTION: Ankle arthrodesis is an increasingly more common procedure performed by orthopedic surgeons for both degenerative and post-traumatic situations. While postoperative infections are relatively low overall, diabetics who require surgical management including ankle arthrodesis are at significantly higher risk. As of 2012, 29.1 million (9.3%) of Americans were affected by diabetes with an incidence of 1.7 million in recent years. Given the high and growing prevalence of diabetes, appropriate management of these conditions in this population is essential. We hypothesize that as HbA1c increases, the rate of postoperative infections will increase as well.

METHODS: A software platform was utilized to investigate a multicenter database of pooled electronic medical records of over 50 million patients from 26 U.S. healthcare networks. A cohort of healthy patients that had undergone ankle arthrodesis was created, and the incidence of 90-day postoperative infections was calculated. This group was compared to cohorts of diabetic patients with hemoglobin A1c <7%, 7-9.9% and >10%. Relative risk and infection incidence were calculated and chi-square analysis was used to determine significance between groups. An additional comparison was made for overall postoperative complication rates.

RESULTS: There were 3,900 patients in non-diabetic patient cohort and 1,530 in the diabetic patient cohort with recorded HbA1c measurements. Overall, patients with diabetes had an increased risk of developing postoperative infection (5.88% vs. 2.56%; relative risk 2.29, $p<0.0001$). Within this cohort, their risk correlated to their HbA1c levels. Patients with HbA1c under 7.0% were found to have a postoperative infection risk of 4.84% (relative risk 1.89, $p=0.0018$). When HbA1c was 7%-9.9%, patients' risk increased to 8.51% (relative risk 3.32, $p<0.0001$). As a patient's diabetes became uncontrolled with HbA1c levels surpassing 10%, postoperative infection rates rose to 10.0% (relative risk 3.9, $p<0.0001$). Overall complication rates were increased in diabetics (9.80% vs. 4.87%; relative risk 2.01, $p<0.0001$).

CONCLUSION: As hemoglobin A1c levels increase, rates of postoperative infection increase in a stepwise fashion following ankle arthrodesis.

Wound Complications with Open Repair of Achilles Tendon Rupture: A Comparison of Two Surgical Approaches

Abstract ID: Poster 090

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INTRODUCTION: The primary concern with open Achilles tendon repair is wound complications, and there is debate in the literature on the safest incision location for this procedure. The objective of this study was to evaluate whether incision location significantly impacts the rate of postoperative wound complications when compared to the historical rates quoted in the literature for Achilles tendon repair.

METHODS: 55 patients with open operatively repaired acute Achilles tendon ruptures at a single tertiary center were identified and treated by 2 foot and ankle fellowship-trained orthopedic surgeons with a direct posterior midline (38 patients) or posteromedial incision (17 patients) with similar soft tissue handling principles. Superficial wound complications/cellulitis or deep wound infections requiring a return to the operating room for debridement alone or with soft tissue coverage were recorded. These rates were compared between groups. The study group as a whole was then compared with historical rates quoted in the literature. No significant differences were seen in patient demographics between the two groups.

RESULTS: There were no significant differences between the posteromedial and posterior incision groups in rates of superficial wound complications (0% versus 7.9%, P=0.54), deep wound infection requiring operative debridement alone (5.9% versus 2.6%, P=0.53) or debridement and soft tissue coverage (0% versus 0%, P=1.0), or total number of wound complications (5.9% versus 10.5%, P=1.0). When the study group as a whole was compared to the historical rates in the literature, no significant differences were seen in superficial (5.5% versus 8.3%, P=0.73), deep (3.6% versus 2.4%, P=0.64), or total wound complications (9.1% versus 9.7%, P=1.0).

CONCLUSIONS: Incision location in acute open Achilles tendon repair did not have an effect on superficial or deep wound complication rates. The authors believe that certain soft tissue handling principles such as avoiding retraction on the skin and avoiding dissection between the peritenon and the superficial subcutaneous tissue may be more critical in helping avoid serious wound complications postoperatively such as rotational or free flap soft tissue coverage.

Treatment of Proximal Fifth Metatarsal Fractures and Re-Fractures in Elite Athletes with Plantar Plating

Abstract ID: Poster 091

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INTRODUCTION: Acute surgical fixation of proximal fifth metatarsal fractures with an intramedullary screw is the surgical treatment standard of care in elite athletes. However, nonunion and re-fractures bring into question the adequacy of intramedullary screw fixation. The purpose of this study is to determine the rates of radiographic and clinical fracture healing, return to sport, and short-term clinical outcomes of elite athletes treated with plantar lateral plating.

METHODS: An IRB-approved retrospective single surgeon case series investigation was performed of athletes competing at a college, Olympic, or professional level with proximal fifth metatarsal fracture or re-fracture that were treated with plantar lateral open reduction internal fixation and calcaneus autograft bone grafting. Non-athletes, and those treated acutely with a different surgical technique, were excluded. Demographic data, clinical and radiographic evaluation, return to sport, and the AOFAS midfoot score were collected and analyzed. Means with standard deviations were calculated for continuous data and frequencies of categorical data were calculated in percentages.

RESULTS: Six re-fractures and two primary fractures were treated in eight male patients with an average age of 21.9 ± 1.9 years old at an average follow-up of 495.9 ± 152.1 days. Two patients experienced a transient sensory neuropraxia of the lateral foot. There were no wound complications, delayed unions or nonunions, re-fractures, hardware loosening, or complaints of hardware prominence. Asymptomatic radiographic union was observed in 100% of the athletes at 6.54 ± 1.1 weeks and a full release was given at 12.3 ± 1.9 weeks. All athletes were able to return to sport at the same level of competition. AOFAS midfoot score was available for all but one athlete with an average score of 96.5 ± 3.25.

CONCLUSION: These early results indicate that plantar lateral plating is an effective and safe technique that may be used for treatment of proximal fifth metatarsal fractures in both the primary and revision setting.

Vitamin D Levels in Patients with Metatarsal Fractures

Abstract ID: Poster 092

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INTRODUCTION: Vitamin D deficiency has been associated with a range of diseases. Among orthopedic patients, insufficiency has been reported between 43% and 78%. Currently, there is conflicting evidence regarding the association of vitamin D deficiency with acute fractures, stress fractures, and nonunions. Furthermore, there is limited literature on vitamin D's effects in foot and ankle patients. The studies purpose is to determine the prevalence of vitamin D insufficiency in patients who have sustained low energy metatarsal fractures compared to non-osseous foot and ankle sprains.

METHODS: Data collection occurred from May 2012 to August 2014. Patients with low-energy closed metatarsal fractures or non-osseous ankle sprains, between 18 and 85 years old, were enrolled. Demographics collected included age, gender, race, BMI, mechanism of injury, smoking status, history of fractures and a previous diagnosis of vitamin D deficiency. Sufficient, insufficient and deficient levels of vitamin D were defined as ≥30ng/ml, 20-30ng/ml, and <20ng/ml, respectively. Categorical data was analyzed using Fisher's Exact test. Serum vitamin D levels were reported in categories and as continuous data. ANOVA was used to assess differences in injury among vitamin D groups.

RESULTS: Of 71 fracture and 28 sprain patients, mean age was 51 and 41 years, respectively. Mean vitamin D level in the fracture group was 26.9±13.0ng/ml and in the sprain group was 27.1±12.8 (p=0.93). Between groups, the omnibus p-value for sufficient, insufficiency and deficiency was 0.81. Predictors of fracture risk were older age (p=0.001), white/non-Hispanic race (p=0.003), female gender (p=0.03), wintertime injury (p=0.02), and smoking (p=0.01). Variation in vitamin D levels, however, did not correlate to these differences. Subgroup analysis showed significantly higher vitamin D levels with calcium and/or vitamin D (p=0.001) supplementation, age >65 years old (p=0.01), non-Hispanic/white race (p=0.05) and a BMI <30 (p=0.01). None of these characteristics independently predicted fracture risk, though the correlation with age may be explained by increased supplement use.

CONCLUSION: There was no difference in the mean vitamin D level or incidence of vitamin D insufficiency between patients with metatarsal fractures versus sprains. No causal relationship was established between vitamin D levels and fractures. An association was found between higher vitamin D levels and vitamin D supplementation and lower BMI. This is one of the first studies in the foot and ankle literature to find no association between vitamin D levels and fractures, demonstrating need for further study of this relationship and stratification by specific fracture locations and types.

Hallux Rigidus Grade Correlates with Age But Not Symptom Severity

Abstract ID: Poster 093

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INTRODUCTION: Classification systems for hallux rigidus imply that as radiographic changes progress, symptoms will concurrently increase in severity. However, symptom intensity and radiographic severity can be discordant for many patients. We studied the relationship between hallux rigidus grade and a commonly utilized outcome instrument – the Foot and Ankle Ability Measure (FAAM) – hypothesizing a correlation between FAAM score and hallux rigidus grade.

METHODS: All new patient visits from January 2008 – December 2012 with a diagnosis of hallux rigidus were retrospectively identified based on billing codes. Patients with prior foot and ankle surgery, bilateral disease, or a diagnosis of diabetes, gout, rheumatoid arthritis, or neuropathy were all excluded. Weight-bearing foot radiographs and FAAM Activities of Daily Living (ADL) questionnaires were both completed at initial presentation. Deidentified radiographs were graded by three fellowship-trained foot and ankle surgeons according to the Coughlin-Shurnas radiographic criteria. In cases of grader-discrepancy, majority grade was used for analysis. Electronic records of patients with a consensus grade 3 were reviewed for an examination revealing pain throughout the entire arc of motion. If present, those subjects were categorized as grade 4. Intraclass correlation coefficient (ICC) and Fleiss' kappa statistic were calculated to assess rater agreement. Sperman's rank coefficient was used to correlate clinical-radiographic grade with age and FAAM ADL scores.

RESULTS: Eighty-four patients with unilateral hallux rigidus and complete FAAM ADL data and radiographs were identified. Counts were grade 1 (N=12), grade 2 (N=34), grade 3 (N=25), and grade 4 (N=13). Surgeons moderately agreed on radiographic grading (ICC: 0.69, $P<0.001$; Fleiss' kappa: 0.49, $P<0.001$). Patients with grade 1 or 2 hallux rigidus were significantly younger ($P < 0.001$) than patients with grades 3 or 4 (average age: 45.4, 46.2, 60.6, and 59.6 years-old, respectively). FAAM ADL scores did not differ by clinical-radiographic grades 1-4 (average: 76.3, 81.2, 81.3, 66.7, respectively; $P=0.43$). Hallux rigidus clinical-radiographic grade showed moderate correlation with patient age ($r = 0.63$, $P<0.001$), but no relationship with FAAM ADL scores ($r = -0.10$, $P=0.36$); therefore, we were unable to prove our hypothesis.

CONCLUSIONS: In hallux rigidus, advancing radiographic changes did not correspond with patient-reported symptoms as measured by FAAM ADL scores. Older patients tended to present to clinic for initial care with more advanced hallux rigidus. Traditional outcome instruments may be unable to detect differences between clinical-radiographic grades for hallux rigidus – even patients with severe radiographic hallux rigidus remained relatively functional as scored by the FAAM ADL.

SPORTS

Clinical Outcomes of ACL Reconstruction in Adolescent Female Athletes

Abstract ID: Poster 094

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BACKGROUND: There is limited information in the literature specifically detailing the outcomes of anterior cruciate ligament reconstruction (ACLR) in adolescent female athletes.

PURPOSE: The purpose of this study was to (1) describe the 2-year clinical outcomes in skeletally mature adolescent female athletes undergoing ACLR and (2) determine if graft selection, concomitant injury, sport, body mass index, etc. affect outcomes.

METHODS: 200 consecutive skeletally mature adolescent females (207 knees) underwent primary isolated ACLR between June 2011 and January 2014 at a single orthopedic outpatient clinic, Patients were asked to return for a physical examination and completion of subjective questionnaires.

RESULTS: Clinical information was available on 114/207 knees with physical examination performed on 86 knees. Ninety-nine of 114 (86.8%) patients were able to return to play. Thirteen (11.4%) knees sustained a graft retear and 11 (9.6%) patients tore their contralateral ACL during the study period. KOOS data demonstrated a mean of 87.6 (14.1) for sports/rec and a mean of 82.1 (14.7) for quality of life subscales. All knees demonstrated a Lachman's exam with less than 5 mm side to side difference. Five knees had rotatory instability with a pivot shift of greater than 2+. Twenty-one (20.8%) knees underwent a subsequent nonrevision surgery on their reconstructed knee.

CONCLUSIONS: This population of skeletally mature adolescent female athletes reported a high rate of return to play (86.8%) with ACL graft retear rate (11.4%) and contralateral ACL tear (9.6%) consistent with other reports on male athletes undergoing ACL reconstruction. The variables of patient's BMI, mechanism of injury, graft type, concomitant meniscal pathology at time of index procedure, or undergoing a subsequent second surgery on the ipsilateral knee did not impact patient reported outcomes or physical exam findings at two years. Overall patient reported outcomes were high even in the setting of the 11.4% retear and 9.6% contralateral tear rates.

The Challenge of Patient-Reported Outcome Collection in Sports Medicine Clinical Practice - An Uphill Battle

Abstract ID: Poster 095

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OBJECTIVES: To determine patient reported outcome (PRO) score collection compliance in Orthopedic Surgery Sports Medicine practice.

METHODS: Three hundred consecutive subjects in one Sports Medicine orthopedic surgeon's practice were eligible for and enrolled in this IRB-approved prospective observational cohort investigation. The presenting chief complaint of new patient evaluations determined which one of three possible groups (hip, knee, shoulder) in which the subjects were categorized. Patients with >1 joint complaint, established patients, patients <18 years old, non-English speaking patients, patients unable to read, and patients unwilling to participate were excluded. Patients received paper copies of each questionnaire at their initial visit. Patients were not coerced or given financial incentive to complete scores. All patients received a Short Form-12 (SF-12) and Tegner activity score. Joint-specific scores were also administered (hip: iHOT-12, Hip Outcome Score, Beighton, Patient Activation Measure [PAM]); (knee: International Knee Documentation Committee [IKDC] subjective, Knee injury and Osteoarthritis Outcome Score [KOOS]); (shoulder: American Shoulder and Elbow Surgeons [ASES], and Western Ontario Rotator Cuff [WORC] index [>40 years of age] or Western Ontario Shoulder Instability [WOSI] index [<40 years of age]. The number and percentage of completed questions and questionnaires was measured. Correlation analysis (Pearson, Spearman) determined the correlation of the number of questions and questionnaires answered with age. Chi-squared was used to determine the significance of the number of questions and questionnaires answered and gender.

RESULTS: 300 subjects enrolled (161 females; 139 males). Subject age was 39.8 +/- 16.3 years. In patients with a chief complaint of hip pain, six individuals (6%) fully completed all 6 questionnaires. In patients with a chief complaint of knee pain, 25 individuals (25%) fully completed all 4 questionnaires. In patients with shoulder pain <40 and >40 years of age, eight (20%) and five (8.5%) individuals fully completed all 4 questionnaires. There was a slight correlation (r= -0.137; p=0.02) with questionnaire completion and age (greater age associated with lower completion). Females completed a significantly greater number (p=0.001) of questions than males (74.6% vs. 72.6%).

CONCLUSIONS: PROs are only worthwhile if they are fully completed by patients. This prospective cohort investigation demonstrated a low overall completion rate (6% to 25%) of paper-based PROs in adults with hip, knee, or shoulder pain presenting to a Sports Medicine orthopedic surgeon. Alternative methods of PRO collection (automated, electronic, research assistant administered) must be sought for greater compliance in the future.

Functional Outcomes 2-11 Years Following Posterolateral Corner Reconstruction in Multi-ligament Knee Injuries

Abstract ID: Poster 096

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PURPOSE: Increasing importance has been placed on the posterolateral corner (PLC) in maintaining varus and rotational stability of the knee. The goal of this study is to evaluate functional knee scores at a minimum of 2 years following PLC reconstruction in patients with multi-ligament knee injuries.

METHODS: This retrospective study identified patients with a multi-ligament knee injury between 2004 and 2013. Patients who received PLC reconstruction during the study period and had a minimum follow-up of 2 years after surgery were included. Functional outcomes were assessed using Lysholm and International Knee Documentation Committee (IKDC) scores. Varus and rotational knee laxity as well as range of motion were assessed using physical examination.

RESULTS: The study cohort included 76 patients with PLC reconstruction following a multi-ligament knee injury. At a mean follow-up of 4.5 years (±2.2 years), the mean IKDC score was 70.7 (±25.9) and the mean Lysholm score was 76.1 (±24.0). The mean postoperative knee range of motion was -1° to 124° at final follow-up. 95% of patients had grade 0 varus laxity in full knee extension and 87% had grade 0 varus laxity at 30° of knee flexion at final follow-up. Patients with combined peroneal nerve and vascular injury were more likely to have a lower postoperative IKDC ($p = 0.03$) score.

CONCLUSION: Surgical treatment of the PLC in the multi-ligament injured knee injury can result in satisfactory functional knee scores at 2 to 11 years following surgery. Combined peroneal nerve and vascular injury at the time of surgery was predictive of lower knee function at final follow-up.

Factors Influencing Return to Sport or Return to Work After a Multiligament Knee Injury

Abstract ID: Poster 097

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OBJECTIVE: Multiligament knee injury represents a spectrum of complex knee injuries; functional outcomes can range from mild impairment to severe disability. The objective of this study is to identify factors influencing the time to return to sport or return to work after a multiligament knee injury to help providers more effectively counsel patients early in the treatment process.

METHODS: A systematic review of the literature was performed on the PubMed database available until January 2016 using keywords “knee dislocation” or “multiple ligament–injured knee” or “multiligament knee reconstruction', resulting in 1586 hits. Prospective and retrospective patient outcome studies reported in English were included. We investigated the effect of age, surgical timing, injury mechanism, treatment strategy, ligaments involved, BMI, vascular involvement, and nerve injury on functional outcomes including return to sport or return to work.

RESULTS: Surgical treatment was generally reported to be superior to non-operative treatment of knees with clinical instability. Earlier surgical treatment (within 3 weeks) in patients without vascular injury was associated with improved outcomes. A higher grade injury as defined by the KD classification is associated with worse outcomes. Morbidly obese patients often had poor outcomes even with low energy injury mechanism or low KD injury grade. Both vascular and neurologic injury were associated with low rate of return to work or sport as well as chronic pain medicine requirement. Injuries that occurred in polytrauma patients often required longer rehabilitation and carried a significant financial burden.

CONCLUSIONS: Injury severity, patient demographics, and presence of associated injuries influence outcomes following multiligament knee injury and should be considered when counseling patients on reasonable expectations for return to sport or return to work.

Modifiable Factors that Affect Elbow Torque During Throwing: Analysis of 81,999 Throws from Professional Baseball Players

Abstract ID: Poster 098

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INTRODUCTION: Despite numerous prevention strategies, elbow injuries are on the rise in professional baseball. This is likely do to the high level of strain exerted across the elbow during the throwing motion. In order to identify at risk athletes and guide post injury return to throw programs, a better understanding of the variables that influence elbow workload is desired. The purpose of this work is to utilize wearable technology to determine the factors that have the greatest influence on elbow torque for baseball pitchers during regular, on-field activities.

METHODS: A total of 88 professional pitchers performed 32,499 throws while wearing an mThrow sensor and sleeve). These throws represented a combination of warming up, structured long toss, bullpen throwing from a mound, and live game activity. The following variables were recorded: distance, pitch type, situation, arm slot, arm speed, shoulder rotation, and elbow torque. Summative performance analysis is reported using means, medians, and ranges for all pitch and throw types. Comparisons between throw types and pitchers were performed using ANOVA with post hoc testing, linear mixed-effect models with likelihood ratio tests, and regression analysis where indicated.

RESULTS: The mean height and weight (± standard deviation) of pitchers was 185.6 ± 5 cm and 93.7 ± 10 kg, respectively. For all throwing situations, arm slot did not significantly affect torque ($p=0.10$). Both arm speed ($p<0.001$) and amount of shoulder rotation ($p<0.001$) affected torque. Within individual athletes, elbow torque increased by 1 Nm for every 103° per second increase in arm speed and/or for every 5° decrease in shoulder external rotation. Torque increased as long toss distance increased ($p<0.001$) and as pitchers moved from long toss to bullpen to games ($p<0.001$). Relative to live game throws, elbow torque was reduced by 1.3 Nm for bullpen throwing, 5.5 Nm for long toss at 120 feet, and 8.2 Nm for long toss at 90 feet.

DISCUSSION AND CONCLUSIONS: To our knowledge, this represents the first report of on-field, practical, and inexpensive wearable technology that can be used to assess workload during the throwing motion. A number of key factors (type of throw, arm speed, and shoulder rotation) that influence the workload exerted on the elbow were identified and quantified. These data may be used to help identify patients at risk for elbow injuries, develop prevention programs, and better guide return to throw programs following injury in baseball.

Osseous Vacularity of the Medial Elbow Following Ulnar Collateral Ligament Reconstruction: A Comparative Analysis of the Docking and Figure of Eight Technique

Abstract ID: Poster 099

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INTRODUCTION: The rate of revision medial ulnar collateral ligament (UCL) reconstruction continues to rise annually, and two common modes of failure for are inadequate healing at the bone-tendon interface or bony fracture through drill tunnels. Although, vascularity may play a critical role in these processes, the intra-osseous blood flow to the medial epicondyle (ME) and sublime tubercle (ST) remains undefined. The purpose of this work was to better understand the vascularity of the ME and ST at baseline and to quantify vascular disruption caused by tunnel drilling for the two most common UCL reconstruction techniques: Figure of Eight and Docking.

METHODS: Eight matched pairs (16 specimens) of cadaveric upper extremities were randomized to one of the two study groups: Docking or Figure of Eight UCL reconstruction. One elbow in each pair underwent drilling of the medial epicondyle and sublime tubercle by the assigned technique, while the contralateral elbow served as a control. Pre- and post- gadolinium MRI scans were performed on all study elbows to quantify intra-osseous vascularity by contrast enhancement, which was compared to the contralateral matched control elbow. Intra-osseous flow was quantified within a standardized region of interest using customized IDL 6.4 software (Exelis, Boulder, Colorado). Following MRI, contrast-enhanced polyurethane latex was injected into all vessels and CT with 3D reconstruction and gross dissection was performed to assess vessel integrity.

RESULTS: MRI quantification revealed drilling of the ulnar tunnels (which was the same for each group) had a minimal impact on intra-osseous vascularity of the ulna with maintenance of 96% and 99% of blood flow for the Docking and Figure Eight techniques respectively ($p=0.448$). However, perfusion to the medial epicondyle was reduced by 14% (to 86% of baseline) for the Docking Technique and by 60% (to 40% of baseline) for the Figure Eight technique. This resulted in a mean difference of 46% in reduced perfusion between the two techniques ($p=0.012$). Subsequent CT analysis and gross dissection revealed increased disruption of small perforating vessels of the posterior aspect of the medial epicondyle for the Figure of Eight Technique.

CONCLUSIONS: Although tunnel drilling in the sublime tubercle appears to have minimal effect on intra-osseous vascularity of the proximal ulna, both the Docking Technique and the Figure of Eight Technique reduce flow in the medial epicondyle. This reduction is four times greater for the Figure of Eight Technique, and these findings may have important implications for UCL reconstruction surgery.

Population-Based Nonoperative Management of Osteochondritis Dissecans: Progression to Osteoarthritis and Arthroplasty Over a 35-Year Period

Abstract ID: Poster 100

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PURPOSE: Osteochondritis dissecans (OCD) is a disorder of the subchondral bone which most commonly affects the medial femoral condyle of the knee. The purpose of this study is to (1) evaluate the rate of arthritis and knee arthroplasty in a population-based cohort of patients with OCD lesions treated non-operatively and (2) evaluate factors that may predispose patients to knee osteoarthritis and arthroplasty.

METHODS: The study included a population-based cohort of 86 patients with OCD between 1976 and 2014. A chart review was performed to collect information related to the initial injury, treatment, and outcomes. Subjects were followed for a mean of 12.6 years to determine if they developed clinically symptomatic arthritis or underwent knee arthroplasty.

RESULTS: 13 patients (15%) were diagnosed with arthritis corresponding to a cumulative incidence of 5.0% at 5 years, 10.0% at 10 years, 20.0% at 25 years, and 30.0% at 35 years. Additionally, 7 patients (8%) underwent knee arthroplasty including 1 patient treated with unicondylar knee arthroplasty and 6 patients with total knee arthroplasty. The mean age at arthroplasty was 58.5 years. The cumulative incidence of arthroplasty was 1.0% at 5 years, 3.0% at 10 years, 8.0% at 25 years, and 8.0% at 35 years. Skeletal maturity at diagnosis (HR 21.7, 95% CI: 2.7, 176.3) and patellar OCD lesions (HR 15.0, 95% CI: 1.3, 345.3) were associated with a significantly higher risk of osteoarthritis.

CONCLUSION: Arthritis following non-operative treatment of OCD lesions is a challenging problem with an estimated 30% cumulative incidence of arthritis at 35 years after diagnosis. Increasing age at diagnosis and patellar OCD lesions are associated with the development of arthritis.

Short- to Mid-Term Outcomes of Anatomic MCL Reconstruction with Achilles Tendon Allograft in the Setting of Multiligament Knee Injury

Abstract ID: Poster 101

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PURPOSE: Multiple techniques have been described in the literature for the repair and reconstruction of the medial collateral ligament. The purpose of this study is to describe functional outcome, range of motion, and knee stability following anatomic MCL reconstruction utilizing an Achilles tendon bone allograft.

METHODS: A comprehensive search of our institution's procedural database was conducted to identify all patients that underwent reconstruction of the MCL utilizing an allograft Achilles bone block and with two-year clinical follow up. Medical charts were retrospectively reviewed to determine each patient's pattern of injury, final range of motion, stability on clinical examination, and the incidence of complications and reoperations. KOOS, IKDC, and Marx scores were also collected.

RESULTS: Twenty-seven knees in 27 patients (17 males and 10 females) with a mean age of 30 years (range, 15–49) were followed for an average of 40 months (range, 28 to 87 months) following MCL reconstruction with Achilles tendon bone allograft. In this series, all patients undergoing MCL reconstruction had multiple injured knee ligaments. 10 patients had concurrent ACL reconstruction, 5 patients PCL reconstruction, and 11 patients had both cruciate ligaments reconstructed. At final follow-up, clinically significant valgus laxity was observed in only 1 patient (3.7%). All patients were able to achieve full extension of the knee and the average flexion was 126° (SD = 14.3). The average IKDC score was 71.9 (range, 39.1-98.8, SD =16.2) and the average KOOS score was 82.2 (range, 60.1-93.5, SD = 10.4). The average Marx score was 5.1 (range, 0-16, SD=5.2). 22 of 23 (96%) patients reported being satisfied with results of the surgery.

CONCLUSION: The technique of MCL reconstruction using Achilles tendon bone-block allograft provides satisfactory knee stability, range of motion, and patient satisfaction at short- to mid-term follow-up.

Risk Factors and Timing of Recurrent Lateral Patellar Dislocation

Abstract ID: Poster 102

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INTRODUCTION: Previous studies have reported variable rates of recurrent lateral patellar instability. Additionally, structural abnormalities have been shown to be risk factors for recurrent instability. The purpose of this study was to evaluate the rate of ipsilateral recurrent lateral patellar dislocation and contralateral patellar dislocation following first-time lateral patellar dislocation. Additionally, factors associated with recurrent dislocation (ipsilateral or contralateral) and time to recurrence will be investigated.

METHODS: This population-based study included 609 patients with a first-time lateral patellar dislocation occurring between 1990 and 2010. A chart review was conducted to gather information about the injury, subsequent dislocation, and structural characteristics such as; patella alta (defined as Caton-Deschamps ≥ 1.3), trochlear dysplasia (Dejour classification), abnormal TT-TG (defined as distance ≥ 20mm). A cumulative incidence model was used to calculate rates longitudinally. Investigated risk factors were assessed to determine if they individually decrease the time to recurrence. Alternatively, a dichotomous model was used to determine if the investigated risk factors are likely to be present in the early recurrence (≤24 months) and late recurrence (>24 months) subgroups.

RESULTS: At mean follow-up of 12.3 years, 183 patients had ipsilateral recurrence and 29 patients had a first-time contralateral dislocation. The cumulative incidence of ipsilateral recurrence was 36.4% at 20 years, while the cumulative incidence of contralateral dislocation was 5.9% at 20 years. Trochlear dysplasia (HR 18.5, 95% CI: 9.7, 37.2), patella alta (HR 8.8, 95% CI: 4.2, 19.2), age ≤18 years at time of first dislocation (HR 2.0, 95% CI: 1.2, 3.6), and female gender (HR 1.7, 95% CI: 1.1, 3.0) were associated with recurrent ipsilateral dislocation in all-comers. Time to recurrence was significantly decrease by trochlear dysplasia (23 months earlier time to recurrence), patella alta (15 months), and age ≤18 years at time of first dislocation (11 months). Risk factors for subsequent contralateral dislocation included patella alta (HR 18.1, 95% CI: 5.9, 62.7) and trochlear dysplasia (HR 8.9, 95% CI: 3.1, 28.3) in the originally dislocated knee.

CONCLUSION: At 20 years, there is a 36.4% cumulative incidence of ipsilateral recurrent lateral patellar dislocation, and a 5.9% cumulative incidence of contralateral dislocation. Trochlear dysplasia, patella alta, age ≤18 years at time of first dislocation, and female gender were all associated with recurrence. Trochlear dysplasia, patella alta, and age ≤18 years at time of first dislocation were predictive of a statistically significant decrease in time to recurrence.

HAND

Bidirectional Barbed Suture Repair in Flexor Tendons: A Novel Technique

Abstract ID: Poster 103

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INTRODUCTION: Repair of flexor tendon ruptures in Zone II remains a challenging problem. Both the flexor digitorum profundus and flexor digitorum superficialis pass within the same fibro-osseous sheath. A suture construct must be employed that maximizes strength while minimizing increases in bulk and friction. Various configurations of barbed suture have been studied and found to be promising solutions to the issues created by these injuries; such techniques have not taken full advantage of the bidirectional orientation of the barbs in the suture in order to prevent distraction at the tendon repair site. This study proposes a repair technique in which all barbs, throughout the length of the repair, are acting to prevent distraction at the repair site.

METHODS: Twenty-four flexor tendons from cadaver specimens were transected to mimic Zone II tendon injuries. Four repair techniques were studied: Amadeo (barbed suture repair), McClellan (barbed suture repair), Kessler (standard, knotted technique), and the experimental configuration (barbed suture repair). The repairs underwent biomechanical testing to examine ultimate load and 2-mm gap force, normalized to cross-sectional area of the tendon.

RESULTS: Prior to normalization to tendon cross-sectional area, the Amadeo technique had a significantly larger force at 2 mm gap than the Kessler ($p < 0.01$) and McClellan ($p < 0.05$) techniques. The ultimate load for the Amadeo technique was significantly larger than that of the Kessler ($p < 0.05$) and McClellan ($p < 0.01$) techniques. Differences were found among techniques when parameters were normalized to the cross-sectional area of the tendon both before transection and after repair. Specifically, the Amadeo technique had a significantly larger force at 2 mm gap than Kessler ($p < 0.05$), and a significantly higher ultimate load than McClellan ($p < 0.05$). There was no statistically significant difference between the novel knotless suture technique and any other repair type.

CONCLUSION: The suture technique developed in this study was found to have equivalent biomechanical strength to the Amadeo, McClellan, and Kessler techniques. Amadeo did have superior 2 mm gap force strength when compared to Kessler and a greater ultimate load than McClellan. The experimental suture technique has sufficient strength of repair in biomechanical testing to be used for flexor tendon injuries, and it eliminates the need for a knot.

Correlation of the Lateral Wrist Radiograph to Ulnar Variance: A Cadaveric Study

Abstract ID: Poster 104

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PURPOSE: Ulnar variance has been implicated as a cause of wrist pathology related to overload with surgical treatment aiming to improve this imbalance; however, the most accurate radiographic measurement technique remains unclear. The purpose of this study was to evaluate three methods for determining ulnar variance and to compare each to direct anatomic measurement in a cadaver model.

METHODS: Ten fresh above-elbow cadaver specimens were fixed in neutral rotation, and standardized fluoroscopic posteroanterior (PA) and lateral wrist images were obtained. A dorsal approach was performed, and ulnar variance was directly measured by two independent investigators with both the cartilage intact and denuded using digital calipers. Ulnar variance was measured radiographically using the lateral, perpendicular, and central reference point (CRP) methods. The reliability of each set of measurements was assessed by the intraclass coefficient, and agreement between radiographic and direct measurements was evaluated by the Bland-Altman method. Differences of 1 mm were deemed clinically significant.

RESULTS: Each method of determining the ulnar variance demonstrated near perfect agreement by the intraclass coefficient. The lateral radiograph method correlated highly with the directly-measured ulnar variance with the cartilage denuded with an average measurement difference of 0.06 mm (range: -0.20 mm to 0.47 mm). No radiographic measurement technique correlated with the ulnar variance with the cartilage intact within the 1 mm cutoff.

CONCLUSIONS: Ulnar variance measured by the lateral wrist radiograph technique correlates highly with the directly-measured osseous ulnar variance. The remaining measurement techniques did not reliably correlate to within 1 mm of the directly measured ulnar variance with 95% confidence. No method was able to accurately account for the articular cartilage at the lunate facet or distal ulnar fossa. While the lateral radiograph has been shown to allow for more reliable standardization of wrist position compared to the PA view, this study also highlights the inherent limitations of utilizing static radiographic images in the evaluation of ulnar variance.

Ulnar Shortening vs. Distal Radius Corrective Osteotomy in the Management of Ulnar Impaction After Distal Radius Malunion

Abstract ID: Poster 105

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INTRODUCTION: Distal radius malunions can lead to various functional deficits. In particular, alterations in ulnar variance can lead to pain, loss of motion, and decrease in grip and pinch strength. We sought to compare the outcomes of isolated ulnar shortening osteotomy (USO) to distal radius osteotomy (DRO) for the treatment of ulnar impaction syndrome following distal radius malunion.

METHODS: We retrospectively reviewed 11 patients with extra-articular distal radius malunions treated for ulnar impaction with isolated USO. This group was compared to a 1:1 age- and sex-matched cohort treated with isolated DRO for the same indication. There was no difference in baseline ulnar variance, radial inclination, or volar tilt between groups. Pain visual analogue scales (VAS), wrist motion, grip strength, radiographic parameters, and perioperative complications were analyzed. Mean follow up was 14.8 months (range, 6 to 44 months).

RESULTS: Pain VAS scores improved from 5.0 to 2.0, with no significant difference between groups ($p = 0.57$). Wrist range of motion improved in both cohorts with the exception of pronation in the USO cohort, which decreased from a mean of 66° to 57° ($p = 0.33$). There was no significant difference between groups in regards to change in range of motion, grip or pinch strength, with the exception of pronation ($p = 0.02$). The mean tourniquet time was shorter in the USO group (97 vs. 124 minutes, $p = 0.13$). One patient in the USO group underwent additional unrelated procedures. When excluding this patient, the difference in tourniquet time became statistically significant ($p = 0.009$). The final ulnar variance was 1.8 mm negative in the USO group and 1.1 mm positive in the DRO group with an improvement of 6.2 mm and 4.3 mm, respectively ($p = 0.23$). There was 1 reoperation following USO for painful nonunion, and 2 reoperations following DRO for persistent ulnar impaction symptoms requiring subsequent USO.

CONCLUSIONS: An improvement in range of motion, grip strength, and VAS with restoration of the radio-ulnar length relationship was observed in both cohorts. With advancements in technique and implant guides, USO is a simpler procedure with a shorter tourniquet time that can be an attractive alternative with acceptable outcomes to address ulnar impaction syndrome after distal radius malunions.

PEDIATRICS

The Impact of Obesity on Pediatric Tibia Fracture Healing

Abstract ID: Poster 107

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INTRODUCTION: Pediatric obesity has been associated with orthopedic conditions such as Blount's disease and slipped capital femoral epiphysis, as well as a higher prevalence and increased risk of extremity fractures. In adults, studies have associated obesity with delayed fracture healing and nonunion. The purpose of this study was to investigate the relationship between obesity and healing of pediatric tibia shaft fractures.

METHODS: We conducted a retrospective review of skeletally immature patients > 2 years old who received initial orthopedic treatment for closed tibia shaft fractures at a Level 1 pediatric trauma center between 2011 and 2015. 77 patients who were initially treated nonoperatively with splinting or casting were included in the study. The patients were divided into two groups: (1) normal weight children (BMI > 5th and < 85th percentile) and (2) overweight and obese children (BMI > 85th percentile). 64% (49/77) of patients were normal weight. 36% (28/77) of patients were overweight and obese. The primary outcome measure was time to healing, defined as time to discontinuation of immobilization. Secondary outcome measures included failure of nonoperative management, nonunion rates, and surgical complications. For statistical analyses, Chi-square and Fisher exact tests were used for categorical variables, and t test was used for continuous variables. Statistical significance was defined as $p < 0.05$.

RESULTS: Time to healing averaged 6.6 weeks in normal weight children compared to 6.7 weeks in overweight and obese children ($p= 0.70$). 7.1% (2/28) of overweight and obese children experienced failure of nonoperative management requiring subsequent surgery compared to 0% (0/49) of normal weight children. There were no surgical complications or nonunions in the study group.

CONCLUSION: Overweight and obese children demonstrate no difference in time to healing of tibia shaft fractures compared to normal weight children. Of interest, the children in this study who failed nonoperative management were overweight and obese, and no normal weight children failed nonoperative management. It is possible that overweight and obese children are more likely to fail nonoperative management of tibia shaft fractures compared to normal weight children. Further research on this topic is warranted.

Pediatric Orthopedic Trauma and Associated Injuries of Snowmobile, ATV, and Dirtbike Accidents: A 19-Year Experience at a Level 1 Pediatric Trauma Center

Abstract ID: Poster 108

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OBJECTIVES: The purpose of this study was to evaluate the type and severity of orthopedic and associated injuries for snowmobile, All Terrain Vehicles (ATV) and motorized dirtbike accidents in a pediatric patient population.

METHODS: 758 patients who presented following either snowmobile (n=87), ATV (n=308), or dirtbike (n=363) related trauma at our institution between 1996 and 2015 were retrospectively reviewed.

RESULTS: A total of 441 axial and appendicular fractures occurred requiring 510 procedures. Snowmobile and dirtbike accidents were associated with a higher rate of fractures (63%, 64%) than the ATV group (50%) ($p = 0.0008$). Snowmobile injuries had the highest rate of spinal (23%) and lower extremity fractures (53%) ($p = 0.0004$). Snowmobile and dirtbike cohorts had higher rate of femur fractures (22%, 17%, $p=0.001$) whereas the ATV cohort had higher rates of upper extremity (18%), hand (11%), scapula (4.6%) and open fractures (28.6%) ($p<0.01$). Head trauma was the most commonly associated injury in 275 patients with the highest rate in the ATV group (44%) who also had the highest rate of no helmet use (76%). Snowmobile and ATV patients had higher ISS (11.3, 9.6) than dirtbike patients (7.8) ($p=0.001$). ATV patients were found to be younger (11.8 years) compared to snowmobile (13.2 years) and dirtbike (13.5 years) ($p<0.01$).

CONCLUSION: Pediatric snowmobile, ATV, and dirtbike accidents result in severe orthopedic and associated injuries with each vehicle demonstrating significantly different injury patterns. Injury prevention should focus on improved safety mechanisms, protective gear, safe areas for off-road vehicle use and strict laws with minimum age requirements.

High Energy Pediatric Scapula Fractures and Their Associated Injuries

Abstract ID: Poster 109

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OBJECTIVES: The purpose of this study was to evaluate pediatric scapula fractures occurring in high-energy motorized vehicle accidents and their associated injury patterns in a pediatric patient population.

METHODS: 1968 pediatric patients who presented after either on-road or off-road motorized vehicle accidents between 1996 and 2015 were retrospectively reviewed. 38 patients were found to have scapula fractures and the remaining 1930 were identified as controls.

RESULTS: A total of 39 scapula fractures occurred in 38 patients. The most common pattern was the AO/OTA 14-A3 (n=32), followed by 14-A2 (n=5), 14-B1 (n=1), and 14-C2 (n=1). Scapula fracture patients experienced higher rate of spine fractures (42% vs. 18%, p=0.001), skull fractures (26% vs. 12%, p=0.02), rib fractures (40% vs. 7.6%, p<0.0001), clavicle fractures (34% vs. 6%, p<0.0001), and upper extremity fractures (58% vs. 21%, p<0.0001) compared to controls. Scapula fracture patients had higher Injury Severity Scores (22.1 vs. 10.8, P<0.0001), thoracic injury (79% vs. 31%, p<0.0001), intracranial hemorrhage (32% vs. 15%, p=0.012), pneumothorax (55% vs. 8%, p<0.0001), and lung contusion (63% vs. 12%, p<0.0001). No difference in mortality was observed for scapula and control patients (5% vs. 2%, p=0.302).

CONCLUSION: Pediatric scapula fractures were not associated with higher mortality rates in this series, but were associated with significant morbidity as demonstrated by high rates of associated intracranial hemorrhage, skull fractures, thoracic injury, upper extremity fractures, and spine fractures compared to control patients. Surgeons who care for pediatric trauma patients should view scapula fractures as an indicator for more significant injuries.

Radiographic Outcomes in Nonoperatively Treated Salter Harris II Distal Radius Fractures

Abstract ID: Poster 110

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INTRODUCTION: Although Salter Harris II (SHII) distal radius fractures (DRFs) occur commonly, no clear treatment guidelines exist. Our primary objective was to determine if specific patient or fracture characteristics were associated with malunion after SHII distal radius fracture.

METHODS: We conducted a retrospective review identifying all patients 18 years of age or younger who underwent nonoperative treatment of SHII DRF at our institution between 2005 and 2015. We recorded patient age, sex, and mechanism of injury. We measured articular surface volar tilt, epiphyseal translation, and ulnar variance on injury, post-reduction and final follow-up radiographs. Fractures grouped into dorsally or volarly angulated categories for subsequent analyses. For dorsally angulated fractures, malunion was defined as any dorsal tilt beyond 0° or positive ulnar variance on final films. For volarly angulated fractures, malunion was defined as >10° of volar tilt or positive ulnar variance.

RESULTS: The study group included 130 patients (99 males, 31 females) with a mean age 12.2 years (range 4.4-18.1 years) and an average follow-up of 197.1 days. Forty-eight percent (62/130) of all fractures met criteria for malunion at final follow-up with rates in the dorsally and volarly angulated groups 50% (56/112) and 33.3% (6/18), respectively. Incidence of malunion in both the dorsally and volarly angulated subgroups was not significantly correlated with initial dorsal tilt, initial translation, post-reduction dorsal tilt, post-reduction translation, post-reduction ulnar variance, mechanism of injury, or age at time of injury ($p > 0.05$ for all analyses).

Of the 42 patients with final radiographs >180 days from injury (mean 483 days, range 184-1819 days), 36 had initially dorsally angulated fractures and 6 had volarly angulated fractures. Of the dorsally angulated group, 21 fractures met criteria for malunion. Patients with malunions had a higher mean age at the time of injury than those without malunion (12.8 vs. 10.7 years, $p=0.02$). CONCLUSION Based on these criteria for malunion, we identified high malunion rates (47.7%) in SHII distal radius fractures treated nonoperatively. Malunion was not associated with initial displacement, post-reduction displacement, mechanism of injury. Malunion was correlated with age at time of injury in dorsally angulated fractures followed >180 days.

Bilateral Hand Dexterity in Children with C5-C6 Birth Brachial Plexus Palsy

Abstract ID: Poster 111

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HYPOTHESIS: Children with an isolated C5-C6 birth brachial plexus palsy (BBPP) are presumed to have normal ipsilateral hand function; however, clinical observation suggests atypical bimanual hand use. We hypothesize that when specifically testing dexterity, the ipsilateral hand would show deficits while the contralateral hand would resemble that of typically-developing children.

METHODS: Data from 32 pediatric patients with isolated C5-C6 BBPP were reviewed, including age, gender, prior shoulder surgery, modified Mallet score, and FDT (Functional Dexterity Test) score. The FDT speeds of each hand were evaluated against age-matched norms. Kendall's tau b was employed to correlate FDT performance with self-assessment of ipsilateral hand function and the modified Mallet score. Student's T-test was employed to determine if FDT speed was affected by gender or prior shoulder surgery.

RESULTS: The average patient age was 8.5 years (range: 3-17) with an equal gender ratio. BBPP affected the left side in 9 patients (all right-hand-dominant), and the right side in 23 patients (19 were left-hand-dominant). Twelve patients had no prior surgeries. Twenty patients had undergone secondary procedures about the shoulder. The average modified Mallet aggregate was 20.7 (range: 15-24). Patients with C5-C6 BBPP performed worse than age and hand dominance-matched norms with the affected ($p=0.0003$) and unaffected hands ($p=0.0001$). This discrepancy worsened bilaterally with age. There was no significant difference between affected and unaffected hands ($p=0.456$); typically-developing children demonstrate a consistent difference between dominant and non-dominant hands throughout growth. FDT speed was not influenced by gender ($p=0.631$) or prior surgical intervention ($p=0.563$). There was no correlation with self-assessment of the affected hand ($p=0.861$) or modified Mallet aggregate score ($p=0.416$).

CONCLUSIONS: Children with upper plexus lesions demonstrate diminished dexterity with both the ipsilateral and contralateral hands. These deficits increase with age, suggesting that these children progress slower than typically-developing peers. The severity of shoulder impairment (modified Mallet score, shoulder surgery) did not correlate with hand dexterity. This study highlights the need to address bilateral hand function in the treatment of children with C5-C6 BBPP.

TUMOR

Outcome and Complications of Free Fibula Reconstruction for Oncologic Defects of the Spine and Pelvis

Abstract ID: Poster 112

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BACKGROUND: Following tumor resection of the axial skeleton and pelvis, reconstructive surgeons are often left with large composite bone and soft tissue defects in a physiological poor host. Vascularized bone transfer, can be used in order to supplement stability to the spine and pelvis however there is a paucity of data on the use of these flaps in the axial skeleton and pelvis. The aim of this study was to review our institution's experience with the use of vascularized fibula reconstruction following an oncological resection in the axial skeleton and pelvis affecting (1) overall survivorship, (2) disease specific survival, both local recurrence and distant disease, (3) union of the fibula, and (4) patient function.

METHODS: We retrospectively reviewed the records of 25 cases of vascularized fibula transfer performed to reconstruct a bony defect following an oncological resection of the spine, sacrum, or pelvis from 2000 and 2014. The cohort consisted of 14 males and 11 females; with a mean age at surgery of 38 years and a mean follow-up of 5 years. The most common pathology was osteosarcoma (n=5).

The vascularized fibula was performed for sacropelvic reconstruction following total sacrectomy (n=6), multilevel vertebrectomy (n=5), external hemipelvectomy and sacrectomy (n=4), hemisacrectomy (n=4), internal hemipelvectomy and hemisacrectomy (n=3), and internal hemipelvectomy (n=3).

RESULTS: The overall 2-, 5-, and 10-year survival was 73%, 53%, and 35%. In regards to disease specific survival, the overall 2-, 5-, and 10-year survival was 76%, 66%, and 44%. No analyzed factor was associated with a worse disease specific survival. Disease recurrence occurred in 7 patients, leading to death in 5 patients. The fibula graft failed in 4 patients. Although not significant, there were no cases of failure when a double rod construct was used compared the 4 failures where a single rod construct was used (P=0.26). The mean time to union was 8 months with an overall union rate of 76%. Following the procedure, the mean MSTS functional score was 16.

CONCLUSION: The free-fibula is considered the work horse vascularized bone graft for extremity reconstruction; however, data on the use of the vascularized fibula in the axial skeleton and pelvis is limited. The results of this study show the fibula can supplement reconstruction and fusion, with graft union in a majority of patients. Currently, we advocate for the use of a double rod construction, as this could potential reduce failure.

Operative Treatment of Sacral Chordomas

Abstract ID: Poster 113

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INTRODUCTION: Since sacrococcygeal chordomas are relatively resistant to chemotherapy and radiotherapy, the mainstay of treatment has been en bloc excision with wide margins, often with a significant morbidity to the patient. Even with surgery, there remains a high risk of local recurrence. The purpose of this study is to expand on our previous report of operatively treated sacrococcygeal chordomas. The purpose of this study is to investigate the oncologic and functional outcome of patients undergoing surgical resection of a sacrococcygeal chordoma at our institution with a focus on (1) overall and disease specific survival, (2) rates of complications and reoperation, and (3) patient function.

METHOD: We identified 80 patients who underwent surgical excision of a sacrococcygeal chordoma from 1980 to 2014. The patients' radiographic and medical records were reviewed for clinical and functional outcomes as well as postoperative complications. There were 26 females and 55 males, with a mean age of 57 years at the time of surgery and a mean follow-up of 7 years (range 1 to 20 years). The mean tumor volume was 445 cm^3. All patients underwent a resection with a curative intent. The resection was accomplished through a combined anterior/posterior (n=41) or a posterior (n=39) approach. Adequate margins were obtained in 55 patients. The most common type of resection was a subtotal sacrectomy (n=72) and the most cephalad resection level was S2 (n=29).

RESULTS: The 10-year disease-free and overall survival was 47% and 64%. Patients where an inadequate margin was obtained at the time of surgical excision were at significantly increased risk of mortality (HR 5.66, P<0.0001) and tumor recurrence (HR 4.43, P<0.0001). Tumor size ≥9 cm in maximal dimension was associated with increased risk of local recurrence (HR 2.48, P=0.01). Postoperative complications occurred in 53% of patients; most commonly wound break down leading to debridement (n=16). The mean Musculoskeletal Tumor Society score was 76%, with patients lower sacral (S3-4) involvement having significantly improved scores compared to patients with higher (S1-2) involvement (83% vs. 67%, P=0.008).

CONCLUSION: Wide margins at the time of surgical excision remains the most important factor in the surgical treatment of sacral chordomas. A high index of suspicion is needed for patients with chordomas, to allow for early diagnosis and surgical excision to obtain a wide margin around a smaller tumor.

OTHER

Safety and Efficacy of New Anticoagulants for the Prevention of Venous Thromboembolism After Hip and Knee Arthroplasty: A Meta-Analysis

Abstract ID: Poster 114

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INTRODUCTION: Venous thromboembolism (VTE) is a common and potentially fatal complication following arthroplasty surgery. There is no consensus on the best method of VTE prophylaxis. Several new anticoagulants have been introduced which allow for easier administration, eliminate the need for monitoring, and easier dosing.

METHODS: We performed a meta-analysis of the published randomized trials to determine which anticoagulant has the best safety and efficacy in hip/knee arthroplasty patients. We searched PubMed, MEDLINE, and EMBASE through January 2016.

RESULTS: Compared to enoxaparin, the relative risk (RR) of VTE was lowest for edoxaban 30 mg once daily (0.49, 95% CI 0.32-0.75), rivaroxaban 10 mg once daily (0.55, 95% CI 0.46-0.66) and fondaparinux 2.5 mg once daily (0.53, 95% CI 0.45–0.63), and highest for dabigatran 150 mg once daily (1.19 95% CI 0.98-1.44). The RR of major/clinically relevant bleeding was lowest for apixaban 2.5 mg twice daily (0.84, 95% CI 0.70-0.99), and highest for rivaroxaban (1.27, 95% CI 1.01-1.59) and fondaparinux (1.64, 95% CI 0.24–11.35).

SUMMARY: Newer anticoagulants that lower the risk of postoperative VTE increase bleeding. No agent proved superior to enoxaparin 30 mg twice daily in preventing VTE or bleeding for arthroplasty patients. This information is critically important to help surgeons when selecting VTE prophylaxis for arthroplasty patients; especially as we enter into bundled payment models in which transparency of complications and financial burdens will occur for physicians/hospitals on any patients with complications, readmissions, and reoperations directly related to VTE prophylaxis.

Factors Used by Program Directors to Select Sports Medicine Orthopedic Surgery Fellows

Abstract ID: Poster 115

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INTRODUCTION: Orthopedic fellowships have been increasing in popularity. As seeking a fellowship becomes more competitive, it is important to determine what fellowship directors desire in applicants. The purpose is to identify factors and characteristics sports medicine orthopedic surgery fellowship directors (SMFD) consider important for applicant selection with respect to offering an interview and ranking.

METHODS: A web-based questionnaire was sent to all orthopedic surgery sports medicine fellowship directors or coordinators who then forwarded the link on. Each criterion was ranked in importance utilizing the 1 to 5 Likert scale, with 1 being not important and 5 being critically important. Directors were asked to rank with respect to four different categories of: granting an applicant an interview, importance of source of letters, importance during an interview, and factors in highly ranking &/or offering a position in the fellowship program.

RESULTS: Thirty-five of 90 (39%) program directors responded. The criteria with the highest mean Likert score for offering an applicant an interview were quality of letter of recommendation (LOR) (4.4 ± 0.7), letters of recommendation commenting on overall technical competence (4.1 ±0.9), and residency program reputation (4.0 ± 0.7). The letters of recommendation with the highest value were from the division chief of sports medicine (3.7 ±1.0) and another sports medicine surgeon in the department (3.6 ±1.0). The most important features of the interview were the applicant's ability to articulate thoughts (4.3 ±0.6), maturity of applicant (4.3 ± 0.7), and ability of applicant to listen well (4.2 ±0.6). The most important factors in ranking a candidate were the applicant's commitment to hard work (4.7 ±0.5), quality of the interview (4.3 ±0.5), quality of letters of recommendations (4.3 ±0.5), and ability to work with other members of the health team (4.3 ±0.8).

CONCLUSIONS: Desirable factors by sports medicine fellowship directors were identified. The factors that were established as important in offering a fellowship interview included quality and content of the LOR. Personal attributes and quality of LOR were highly valued in applicant selection for sports medicine fellowships. These findings can serves as a guide to improve the fellowship application process for both programs and applicants.

Bioconjugate Enhanced Fusion of Orthopedic Pins in a Rat Femur Model

Abstract ID: Poster 116

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INTRODUCTION: Studies have documented the role bone morphogenetic proteins (BMP) play in inducing bone and cartilage formation. However, clinical utility is limited because the high doses required and systemic diffusion of the proteins causing untoward effects in local tissue. Short peptide bioconjugates were discovered that increases osteogenic signaling and mineral deposition in human mesenchymal stem cell (hMSC) populations over three weeks. This allows for a scalable and cost-effective alternative to BMP recombinant proteins. Additionally, the spatial presentation and concentration of these short peptide sequences at the implant-tissue interface may allow for a more robust osseointegration of titanium (TiO2) implants without negative local effects. TiO2 pins were coated with bioconjugates consisting of a dendron base, bioactive short peptide domains, and surface binding catechol domains. They were then implanted in rats to evaluate the bone-implant interface compared to uncoated pins. We expect the bioconjugate coated pins to fuse stronger and more quickly than uncoated pins.

METHODS: Multivalent TiO2 binding dendrons containing short peptide sequences (e.g., OGP-dendron) were bonded to titanium pins. These pins are being implanted in 78 outbred adult male (350-450g) Sprague-Dawley rat femurs and are removed after 2 and 5 weeks following IACUC guidelines. The rats were randomly assigned to 5 study groups depending on the coating applied to the TiO2 pins; uncoated, osteogenetic growth peptide (OGP), BMP2, BMP7, or BMP9. MicroCT data normalizes pull out strength values based on surface area measurements. Results will be qualitatively analyzed histologically and quantitatively analyzed with biomechanical pull-out testing.

RESULTS: Short- and long-term evaluation has been completed for the control and OGP groups. The remaining groups are currently in progress. Preliminary data demonstrates significantly higher pullout forces for the OGP group compared the control group (14.01 N vs. 6.33 N, $p=0.023$) at 2 weeks; but not at 5 weeks (39.79 N vs. 42.29 N, $p=0.86$) after normalization for bone-implant interface cross-sectional area.

DISCUSSION AND CONCLUSION: Bioconjugate coated titanium implants may have broad applications within the field of orthopedic surgery in instances that require a fusion at a bone-implant interface. There is potential benefit within total joint arthroplasty, pedicle screw constructs, interbody fusion implants, external fixation, and plate and screw fixation. Future work may include animal studies with orthopedic specific applications and safety studies evaluating long-term effects of bioconjugate coated titanium pins.

Direct Delivery of Bone Morphogenetic Protein-2 and Fibroblast Growth Factor-2 Plasmid Genes for Diabetic Fracture Healing in a Rabbit Model

Abstract ID: Poster 117

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Dr. Bedard was the recipient of a Mid-America Orthopaedic Association poster award.

BACKGROUND: Previous evidence suggests individuals with Type 1 diabetes mellitus have increased incidence of nonunion, delayed union, and pseudoarthrosis. Treatment with bone morphogenetic protein-2 (BMP-2) and fibroblast growth factor-2 (FGF-2) proteins have been investigated to improve the altered callus formation and gene expression in diabetic fracture healing. A novel gene delivery of BMP-2 and FGF-2 plasmid genes has not been analyzed in diabetic fracture healing. The purpose of this study was to analyse the effects of a unique gene delivery modality on chronic diabetic fracture healing in a rabbit model.

METHODS: Eighteen New Zealand white rabbits underwent induction of Type 1 diabetes with alloxan and were maintained diabetic for six months. Six months following induction of diabetes mellitus, collagen scaffolds loaded with either BMP-2 plasmids, FGF-2 plasmids, BMP-2/FGF-2 (combination) plasmids, or radius autograft were placed into a ten millimeter diaphyseal radius defect. Four weeks following surgery, rabbits were sacrificed. Following sacrifice, orthogonal radiographs and micro computed tomography (micro CT) scans were done to analyze for new callus formation. Further analysis of the callus was done with histomorphometric analysis with hematoxylin and eosin (H&E) and Masson's trichrome stain. A student's t-test was used to evaluate significance of new callus volume between the groups.

RESULTS: Micro CT revealed significantly increased bone volume in the combination group (133.7 mm^3) compared to BMP-2 group (88.2 mm^3) ($p=0.029$). There was a trend toward increased bone volume in the autograft group (136.4 mm^3) compared with BMP-2 group ($p=0.059$). There was no difference in bone volume comparing the combination group with autograft ($p=0.937$). In addition, there was significantly more bone area on histologic analysis of the combination group (11.0 mm^2) compared to BMP-2 only group (4.6 mm^2) ($p=0.033$) and FGF-2 only group (3.2 mm^2) ($p=0.02$). There was a significant increased union rate in the combination compared to the BMP-2 only group ($p=0.033$). Fracture union was found in 7 fractures (64%) of the combination BMP-2/FGF-2 group, 2 fractures (40%) in the autograft group, 1 fracture (25%) in the FGF-2 group, and none in BMP-2 group.

CONCLUSIONS: There is no significant difference between bone volume between autograft and use of combination BMP-2/FGF-2 plasmid scaffolds in a chronic Type 1 diabetic rabbit model. Nonviral gene delivery of BMP-2/FGF-2 may be a less morbid treatment modality than

autograft in the setting of a diabetic patient. Further research is needed to explore this treatment option as a possibility in diabetic fracture healing.

Application to Match: Evolution of Medical Student Preferences During the Orthopedic Application Process

Abstract ID: Poster 118

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BACKGROUND: The process of the application to match is a thorough undertaking for graduating medical students and residency programs. The factors that determine final rank lists vary substantially. The authors are unaware of any studies that examined how applicant preferences evolve over the application process. Our goal is to examine how students' preferences develop from the beginning of the application process to rank list formation.

DESIGN: A questionnaire was developed to evaluate the thought progression of the MS-IV orthopedic applicant during both the interview and application processes, comparing individual pre and post responses. The study was sent to all applicants (674) at a southern, academic orthopedic residency upon receiving their application and again following rank list formation. Individual responses were compared pre and post. Questions pertained to school's geographic location, number/location of programs they applied to, class rank, areas of importance to the applicant, and perceptions of applicant characteristics preferred by programs, number of interviews needed to feel comfortable matching, and how closely they scrutinized the programs to which they applied.

RESULTS: 139 and 59 applicants filled out the initial and follow-up studies, respectively. The average number of programs applied to:invitations received was 86:16 (1-148:2-47). The majority of respondents were from the south region and there was a tendency for a disproportionate number of programs applied to, and thus, invitations received in the home region. When applying, students perceive their STEP 1 and interview/Sub-I performances as how programs focus on evaluating students, while perceived STEP 1 importance fell later. When it came to their own preferences, highest emphasis was on geographic location, having rotated at, and current resident similarity to their own personality in the application process, but with increasing variability following rank formation, resident interaction ranked highest. Out of a total of 13 options, the lowest emphasis post rank was assigned to the category titled "I was told I would be ranked high."

CONCLUSIONS: Medical students in this study based their application mostly on static factors such as geography, but rank list formation relies mostly in-person exchanges, highlighting the importance of the away rotation and interview day experiences. There was also much more variance in what applicants hold important when it comes time to rank. The data also implicates the minimal effect of informing residents of their competitive rank. Interactions with their future formed the strongest bases for how preferences changed during the process.

Implantable Rare Earth Magnet Device for Prosthetic Attachment Assessed in a Pilot Goat Model

Abstract ID: Poster 119

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INTRODUCTION: Load transmission through traditional, socket-based prostheses imposes abnormal stresses on residual limb tissues often causing skin breakdown. Improved methods of force transmission in prosthetic design are needed for active patients, including U.S. military with combat-related limb loss. The concept of prosthetic suspension providing secure attachment to the limb and allowing force transmission without inducing tissue breakdown was explored. Objectives of this proof-of-concept study were to assess surgical implantation of rare earth magnetic materials within the residual limb of a goat following trans-metacarpal amputation and determine whether contact pressures between prosthesis and limb were affected by magnetic repulsive forces.

METHODS: Three female goats (Capra aegagrus hircus), 5 years of age (mean 62 kg), were used. Unilateral mid-metacarpal amputation was performed. A titanium alloy implant was inserted into the medullary canal. At the implant's distal end, a neodymium (NdFeB) magnet was hermetically sealed from tissue contact. Anatomical measurements and cast moldings of the residual limb were used to construct a custom prosthetic device. An external magnet or non-magnet control was placed in this modified device to assess effects of magnetic force repulsion. Dynamic contact pressures were collected at multiple limb-socket locations during a series of externally applied loads (6-10 lbf).

RESULTS: Surgical implantation of the magnet devices was uneventful. All animals recovered and were fitted with external prosthetic limbs. Two goats were euthanized at 4 to 6 weeks post-amputation due to unexpected wound healing complications of the residual limb. The remaining goat was utilized to obtain dynamic contact pressure measurements within the customized prosthetic device. Using the non-magnetic control, contact pressures at the distal end of the stump measured 17 to 25 psi with external loading applied to the prosthetic limb. With an external magnet, repulsive forces against the internally implanted magnet resisted the load application and reduced contact pressures distally by 40%-50% (8 to 15 psi) compared to control. The axially directed magnetic repulsion also shifted the contact of the limb to the anterior socket.

CONCLUSIONS: Large animal amputation models present many difficult challenges even in a controlled research environment. We successfully implanted a rare earth magnet device within the residual limb that reacted with a modified prosthetic socket to reduce and re-distribute contact pressures at the limb-socket interface using magnetic force repulsion. It may be possible with more sophisticated magnetic arrays to provide multi-directional stability and non-contact connection between patient and prosthesis.

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Ellis, R. Tyler	n
Ellis, Scott J.	n
Emblom, Benton A.	1, 3b, 5 – Arthex, Inc.; 5 – Smith & Nephew
Endres, Terrence J.	n
Engel, Jamie L.	n
Erickson, Lauren	n
Erossy, Michael	n
Esterle, Andrew	n
Estes, A. Reed	n
Estrera, Kenneth A.	n
Etemad-Rezaie, Ali	n
Etscheidt, Jordan	n
Evans, Laura J.	n
Evans, Timothy	n
Everhart, Joshua S.	n
Fajardo, Roberto J.	5 - Stryker

Falgout, David M.	n
Farid, Yasser	n
Fealy, Stephen A.	1 – DJ Orthopaedics
Feder, Oren I.	n
Fehringer, Edward V.	1, 2, 3b – Wright Medical Technology, Inc.; 7 - Elsevier
Femino, John E.	n
Fillingham, Yale A.	n
Finkler, Elissa S.	n
Finnan, Ryan P.	n
Fitz, David W.	n
Fitzgerald, Steven F.	n
Flanigan, David C.	3b – Ceterix, CONMED Linvatec, DePuy, a Johnson & Johnson Company, Vericel; 3b, 5 – Musculoskeletal Transplant Foundation, Smith & Nephew, Zimmer; 5 – Aesculap/B.Braun, Histogenics, Moximed
Fleissner, Paul R.	2, 3b, 5 – Exactech, Inc.
Fleming, Shane M.	n
Flierl, Michael A.	5 - Stryker
Floccari, Lorena V.	n
Flood, David L.	4 - Pfizer
Flurin, Pierre-Henri	1, 3b – Exactech, Inc.
Foster, Sara	n
Fox, Hannah K.	n
Foyil, Sarah R.	n
Frank, Rachel M.	n
Franke, Kristina	3b - Employed by Quintiles which is a CRO that conducts contract research for most/many biopharma companies and products
Franko, Orrin	3b – CARE, LLC, Insights Orthopedics, Lineage Medical, LLC, NewportMed Inc., www.SurgiSurvey.com, www.TopOrthoApps.com; 3b, 4 – DocSpera; 3c – www.OrthopaedicsOne.com; 3c, 4 – Computer Aided Rehabilitation and Education
Fredericks, Doug	5 – Berkeley Advanced Biomaterials, Biostructures, Bioventus, Orthogem, OrthoRebirth, Sirakoss
Freedman, Brett A.	6 - Medtronic
Freeman, D. Carl	n
Freeman, Katie L.	n
Freking, Will	n
Fricka, Kevin B.	2, 3b – Smith & Nephew; 2, 3b, 5 – Zimmer; 5 – INOVA Health Care Services; 6 - OrthoCareRN
Frisch, Nicholas B.	2 – 3M; 4 - PeerWell
Froehle, Andrew A.	n
Fu, Freddie H.	3a – Medicrea; 7 – Wolters Kluwer Health
Fullick, Robert K.	3b – Exactech, Inc.
Gabbard, Michael D.	n
Gabra, Joseph N.	n
Gage, Brian F.	n
Gambone, Andrew	n
Gammon, Lee	n
Ganesh, Rajan	n
Ganti, Beejal R.	n
Ganz, Reinhold	4 – Examedical S.P.A., Italy
Gao, Yubo	n
Garbis, Nickolas G.	2 - Tornier
Gauger, Mitchell	n

Gebhart, Jeremy JJ.	n
Gelman, Scott E.	n
George, Albert	n
George, Jaiben	n
Gerrie, Brayden J.	n
Ghanem, Ismat B.	n
Gholson, J. Joseph	n
Gibbs, Daniel	n
Gilbertson, Jeffrey A.	n
Gillespie, Robert J.	2, 3b – DJ Orthopedics, Wright Medical Technology, Inc.
Gioe, Terence J.	3b, 6 – DePuy, a Johnson & Johnson Company; 4 – Eli Lilly, Johnson & Johnson
Giveans, M. Russell	3b – Ortholink Pty Ltd.
Glass, Natalie A.	n
Gniadek, Julia	n
Goetz, Devon D.	n
Gogola, Gloria R.	n
Goldberg, Benjamin A.	1 – Aston Medical; 2, 3b – Acumed, LLC, Allen Medical, Aston, Medwest/Arthrex, Stryker
Goldstein, Jeffrey M.	2 – DePuy, a Johnson & Johnson Company
Goldstein, Wayne M.	1 – Innomed, Smith & Nephew; 1, 3b – DePuy, a Johnson & Johnson Company
Gonzalez, Mark H.	1 – Biomet, Johnson & Johnson, Zimmer; 3b – Smith & Nephew; 4 – Ortho Sensing Technology
Goode, Sarah	n
Goodman, Zachary A.	n
Gossett, Leland E.	n
Gossett, Timothy D.	n
Gotha, Heather E.	n
Gould, Gregory	n
Gowda, Ashok L.	n
Goyal, Kanu	n
Gradisar, Ian M.	3b – Exactech, Inc.
Grant, Tanner W.	n
Graves, Matthew L.	2, 3b – DePuy, a Johnson & Johnson Company, Synthes
Grear, Benjamin J.	7 – Saunders/Mosby-Elsevier
Greco, Chaeli	n
Gregory, James M.	n
Greiner, Justin J.	n
Grimsrud, Courtney M.	n
Gruson, Konrad I.	2 – DePuy, a Johnson & Johnson Company; 4 – Amgen Col, Bristol-Myers Squibb, Eli Lilly, GlaxoSmithKline, Johnson & Johnson, Medtronic, Merck, Pfizer, Procter & Gamble, Stryker, Zimmer
Guanciale, Anthony F.	n
Guetschow, Brian	n
Guille, James T.	3b – Anthracite Orthopaedics
Gupta, Sumit K.	n
Guthrie, S. Trent	n
Hadden, Kristie	n
Hake, Mark	5 - Zimmer
Hakeos, William M.	4 – Sentio MMG
Hall, Deborah J.	3b, 5 – Wright Medical Technology, Inc.
Hallock, Justin D.	n
Halperin, Lawrence S.	4 – Avanir Pharmaceuticals, Pfizer, Sanofi-Aventis, Smith & Nephew,

	Workflow.com
Hamilton, Kendall	n
Hancock, Kyle J.	n
Hanson, Chad	n
Hannon, Charles P.	n
Hanson, George	n
Hanson, Logan F.	n
Hanssen, Arlen D.	1 – Stryker; 7 – Elsevier
Hardt, Kevin D.	5 - Medacta
Harmsen, William S.	n
Harnois, Kathleen	3b - Philips
Harris, Joshua D.	2 – Ossur; 2, 3b, 5 – Smith & Nephew; 3b – Applied Biologics, NIA Magellan; 5 – DePuy, a Johnson & Johnson Company; 7 – SLACK Incorporated
Hartigan, David E.	n
Hartman, Curtis W.	2, 3b, 5 – Smith & Nephew; 3c - Trak Surgical, Inc.; 5 – Pfizer
Harvin, William H.	n
Harwood, Jared L.	n
Hassan, Omar	n
Hatem, Stephen F.	4 – Bristol-Myers Squibb, Pfizer, Zimmer
Hayden, Andy M.	n
Hayes, Ann M.	n
Hedrick, Josie	n
Heidenreich, Mark J.	n
Heilmann, Kris	n
Helfrich, Mia	n
Hendricks, Kelly J.	n
Hendrickson, Nathan R.	n
Hernandez, Nicholas M.	n
Hettrich, Carolyn M.	5 - Tornier
Hevesi, Mario	n
Hidden, Krystin A.	n
High, Robin	n
Higuera, Carlos A.	2 – Convatec; 3b – Pfizer, Zimmer; 3b, 5 – KCI; 5 – CD Diagnostics, Cempra, Cymedica, Myoscience, OREF, Orthofix, Inc., Pacira Pharmaceuticals, Inc., Stryker
Hippensteel, K. J.	n
Hodrick, Jeffrey T.	3b - Stryker
Hoegler, Joseph J.	n
Hoernschemeyer, Daniel G.	1, 3b, 4 – Orthopediatrics; 2, 5 – Biomarin; 5 – Stryker Spine
Hoffman, Dustin C.	n
Ho, Sherwin W.	1, 2, 3b, 6 – Biomet; 6 – Athletico Physical Therapy Co, Bioskin, DJ Orthopaedics, Smith & Nephew: fellowship support through OREF, Breg: Support for annual Orthopedics course
Hogue, Matthew H.	n
Hollnagel, Katharine	n
Holt, Andrew M.	n
Holte, Andrew J.	n
Holtorf, Heidi L.	n
Hood, Hunter W.	n
Horazdovsky, Ryan D.	n
Houdek, Matthew T.	n
Howard, Jason	n
Howard, Jennifer S.	n

Howe, Benjamin M.	n
Hoyen, Harry A.	2, 3b – Lima, Stryker; 2, 3b, 4 – Axogen; 4 - Carbofix
Hsu, Erin L.	3b – Bacterin, Vioventus, CeramTec, Globus Medical, Graftys, Lifenet, Medtronic Sofamor Danek, Pioneer Surgical, Relievant Medsystems, RTI, SI Bone, Spinesmith, Stryker, Terumo, Zimmer; 5 - Medtronic
Hsu, Wellington K.	1, 3b – Stryker; 2, 3b – AONA; 3b – Bacterin, Bioventus, CeramTec, Globus, Graftys, Lifenet, Medtronic Sofamor Danek, Mirus, Relievant, Rti, SI Bone; 5 - Medtronic
Huddleston, Paul M.	n
Hudson, Ian	n
Hussain, Mohammed	n
Inabathula, Avinash	n
Incavo, Stephen J.	1 – Innomed, Kyocera, Osteoremedies, Smith & Nephew, Wright Medical Technologies, Inc.; 1, 3b – Zimmer Biomet; 4 – Nimbic Systems
Igram, Cassim M.	n
Inabathula, Avinash	n
Ireland, Philip H.	n
Ishikawa, Susan N.	n
Ishmael, Marshall K.	n
Ismaily, Sabir	n
Israel, Heidi	n
Ituarte, Felipe	n
Ivy, Andre	n
Izadpanah, Ali	n
Jacobs, Cale A.	6 – Aesculap/B.Braun, Smith & Nephew, Stryker, Zimmer
Jacobs, Joshua J.	3b, 5 – Medtronic Sofamor Danek; 4 – Implant Protection; 5 – Nuvasive, Zimmer Biomet
Jamieson, Marissa D.	n
Jang, Yohan	n
Jebson, Peter J.	2 – Synthes AO/ASIF; 4 – Axogen; 7 – Elsevier (book royalties)
Jenkins, Tyler J.	n
Jernigan, Edward	n
Jin, Xin	n
Johnson, Alyssa	n
Johnson, Jeffrey E.	1 – Wright Medical Technologies, Inc.; 3c, 4 – Crossroads Medical; 4 – Extremity Development Corporation; 6 – Arthrex, Inc.- Institutional Support for Fellowship
Johnson, Jeremiah	n
Johnson, Joshua D.	n
Johnson, Nicholas R.	n
Johnson, Paul R.	n
Johnson, William B., Jr.	n
Jonard, Brandon W.	n
Jones, Grant L.	5 – OrthoSpace; 6 – Musculoskeletal Transplant Foundation
Jones, Hugh L.	n
Jones, Kerwyn C.	3b - Orthopediatrics
Jung, Edward	n
Junko, Jeffrey T.	3b – Synthes, Tornier
Kaar, Scott G.	n
Kadri, Omar	n
Kajy, Marvin	n
Kakar, Sanjeev	3b – AM Surgical, Arthrex, Inc., Skeletal Dynamics; 4 – Sonex Healthcare

Kampa, John	n
Kane, Justin M.	n
Karadsheh, Mark S.	7 - Orthobullets
Karalius, Vytas P.	n
Karam, Joseph A.	n
Karam, Matthew D.	n
Karunakar, Madhav A.	n
Kayupov, Erdan	n
Kearns, Sean M.	n
Keeney, James A.	n
Keller, Robert A.	n
Kelley, Todd C.	n
Kelly, Derek M.	2 – Medtronic; 7 – Elsevier Health
Kelly, Mick P.	n
Kempton, Laurence B.	n
Khalil, Lafi	n
Khan, Safdar N.	n
Khanna, Rajan	n
Kharrat, Khalil E.	3c – Fradis, 3K, France
Kheir, Michael M.	n
Khoriaty, Justin	n
Khorsand Sourkohi, Behnoush	n
Khoury, Jane C.	n
Kiefhaber, Thomas R.	n
Killen, Cameron	n
Kim, Ryan S.	n
Kink, Shaun	4 – Mylan Pharmaceuticals
Kirsch, Jacob	n
Klag, Elizabeth	n
Klavas, Derek M.	n
Klein, Sandra E.	n
Kliethermes, Stephanie T.	n
Klika, Alison K.	n
Klimaski, David	n
Klinger, Craig E.	n
Knapik, Derrick M.	n
Kokubun, Brent A.	n
Kolowich, Patricia A.	n
Kopp, Benjamin J.	n
Kothari, Anai	n
Kothari, Zarin	n
Kotwal, Suhel	n
Koueiter, Denise	n
Krebs, J. Collin	n
Kreichati, Gaby E.	n
Krishnamurty, Anil	n
Krumme, John	n
Krych, Aaron J.	3b – Arthrex, Inc.; 5 – Arthritis Foundation, Ceterix, Histogenics
Kunas, Grace	n
Kuo, Paul	n
Kurowicki, Jennifer	n
Kwasny, Mary J.	n
Kyle, James B.	n

Kyle, Richard F.	1 – DJ Orthopaedics, Smith & Nephew, Zimmer
Lachiewicz, Paul F.	1 – Innomed; 2 – Mallinckrodt Pharmaceuticals; 2, 3b – Pacira Pharmaceuticals, Inc.; 3b – Gerson Lehrman Group, Guidepoint Global Advisors; 5 - Zimmer
Lack, William D.	n
Lambert, Bradley S.	n
Lanzinger, William	n
Larsen, Christopher G.	n
Larson, A. Noelle	3b – K2M, Orthopediatrics
Larson, Dirk R.	n
Laskovski, Jovan R.	3b – CONMED Linvatec, Smith & Nephew
Lattermann, Christian	3b – Cartiheal, Vericel; 5 – Smith & Nephew
Laughlin, Richard T.	2 – AO North America, Smith & Nephew, Synthes; 3b – Premier Health Partners Orthopaedic Institute, South Surgery Center, LLC, World Arthrosis Organization; 3c – Community Tissue Bank; 5 – AOFAS (Grants), Ohio Third Frontier, OTA, Wright State University Boonshoft School of Medicine
Law, Tsun yee	n
Lawless, Matthew	6 – MSM, LLC
Lawton, Cort	n
Lawton, Jeffrey N.	3b – Innomed; 5 – Synthes; 6 – AO North America
Lazaro, Lionel E.	n
Le, Theodore T.	n
Lee, Cody S.	n
Lee, Elizabeth D.	n
Lee, Jessica H.	
Lee, Michael J.	3b – DePuy, a Johnson & Johnson Company, Stryker
Lee, Nicolas H.	n
Lemos, Stephen E.	5 – Arthrex, Inc., CONMED Linvatec, DePuy, a Johnson & Johnson Company, Smith & Nephew
Levine, Brett R.	3b – Link Orthopaedics, McGraw-Hill, Merete; 5 – Artelon, Biomet, Zimmer
Levy, Benjamin J.	n
Levy, Bruce A.	1 – VOT Solutions; 1, 3b, 5 – Arthrex, Inc.; 3b, 5 – Smith & Nephew; 5 – Biomet, Stryker
Levy, Jonathan C.	1 – Innomed; 1, 3b – DJ Orthopaedics; 3b – Globus Medical; 5 – Biomet, Rotation Medical, Tornier
Lewallen, David G.	1 – MAKO/Stryker, Pipeline; 1, 3b – Zimmer Biomet; 3b – Link Orthopaedics; 3b, 4 – Acuitive; 3c, 4 – Ketai Medical Devices
Lewallen, Laura W.	1, 5 – Zimmer (family member); 2 – Osteotech (family member); 3b, 4 – Pipeline Biomedical (family member)
Lewis, Robert B.	n
Li, Xing	n
Liberman, Shari R.	n
Lin, Hannah	n
Lin, James	n
Linnell, Joshua D.	n
Lintner, David M.	n
Littleton, Travis W.	n
Littrell, Laurel A.	n
Liu, Jiayong	n
Liu, Max	n
Liu, Steve S.	n
Liu, X. Shawn	3a, 4 – Genzyme; 4 – Regulus Therapeutics

Liu, Xiaochen	n
Livshetz, Isaac	n
Lombardo, Daniel J.	n
Lonergan, Timothy M.	n
Lorbeer, Karly	n
Lovecchio, Francis	n
Luckenbill, Daniel B.	n
Lunati, Matthew P.	n
Luong, Derek	n
Lux, Nathan	n
Lyden, Elizabeth	n
Lynch, Jonathan	n
Mabry, Tad M.	n
Macalena, Jeffrey A.	2 – Arthrex, Inc., Smith & Nephew, Vericel
Mack, Andrew W.	n
Mack, Christina	3a, 4 – AstraZeneca (husband); 3b – Multiple pharmas as Quintiles employee, no direct compensation based on product performance
Macpherson, Alexandra	n
Madsen, Adam A.	n
Magnussen, Robert A.	5 - Zimmer
Mahan, M. Chad	n
Mahoney, Craig R.	2 – Applied Biologics; 3b – Biocomposites, Inc.; 3b, 4 – Trak Surgical, Inc.; 3b,5 – Smith & Nephew; 5 – Johnson & Johnson, Liventa Biosciences
Makhni, Eric C.	7 - Springer
Maldonado, Andrés A.	n
Malempati, Chaitu S.	n
Malik, George	n
Malkani, Arthur L.	1, 2, 3b, 5 - Stryker
Malone, Kevin J.	n
Manista, Gregory	n
Manning, David W.	1, 3b – Biomet; 2, 3b – Medacta; 4 - Iconacy
Marchwiany, Daniel A.	n
Markel, David C.	1, 2, 3b, 5 – Stryker; 2 – Halyard; 4 – Arboretum Ventures, The CORE Institute; 5 – OREF, US Veteran Administration
Markel, Jacob F.	1, 2, 3b, 5 – Stryker; 4 – The CORE Institute; 5 - OREF
Marra, Guido	1, 3b - Zimmer
Marshall, Nathan E.	n
Marston, Scott B.	n
Martin, Adam J.	n
Martin, Jim	n
Martin, John R.	2, 3b - Biomet
Mascioli, Anthony A.	3b – Olympus Endoscopy, Smith & Nephew
Maskill, John D.	3b – Wright Medical Technology, Inc.; 5 - Pfizer
Massey, Lauren E.	3a, 4 – Eli Lilly
Massey, Patrick A.	n
Mathews, Vasilios	n
Matthias, Robert C.	n
Mauffrey, Cyril	3b, 3c – Stryker; 5 – Carbofix, Osteomed; 6 – Abbott, DePuy, a Johnson & Johnson Company; 7 - Springer
May, Jedediah H.	n
Mayer, Megan N.	n
McAlister, Ian P.	n
McArthur, Benjamin A.	n

McCarty, Scott	n
McClanahan, Robert	n
McCormick, Jeremy J.	2, 3b, 5, 6 – Wright Medical Technology;5, 6 – Midwest Stone Institute; 6 – Arthrex, Inc.
McCreary, Dylan L.	n
McCulloch, Patrick C.	n
McDermott, Scott	n
McGarry, Sean V.	3b, 5 – Musculoskeletal Transplant Foundation
McGinty, Jasmin L.	n
McHugh, Michael A.	n
McIntosh, Amy L.	n
McKinley, Todd O.	3b - Bioventus
McLaughlin, Jeffrey R.	1, 2, 3b, 5 - Biomet
McLendon, Paul B.	n
McManus, Benjamin	n
McMellen, Christopher J.	n
McNeilan, Ryan	n
Meftah, Morteza	2 - SwiftPath
Meghpara, Mitchell B.	n
Mehle, Susan C.	n
Mehran, Nima	n
Mejia, Alfonso	5 – Acumed, LLC, Arthrex, Inc., Smith & Nephew, Synthes
Meneghini, R. Michael	1, 3b – DJ Orthopaedics, Stryker; 3b – Osteoremedies; 4 - PixarBio
Mercer, Shawn	n
Meta, Fabien	n
Michalek, Joel E.	6 - Pfizer
Mihalko, William M.	2 – CeramTec Medical Products; 2, 3b, 5 – Aesculap/B.Braun; 3b – Zimmer; 5 – Department of Defense, MicroPort, Stryker; 7 – Saunders/Mosby-Elsevier, Springer
Milbrandt, Todd A.	3b – Orthopediatrics; 4 – Viking Scientific; 6 - Broadwater
Milia, Marc J.	4 - Stryker
Millar, Emily	n
Miller, Benjamin J.	2 – DePuy, a Johnson & Johnson Company
Miller, Eric T.	3b, 3c - Synthes
Miller, Matthew A.	n
Miller, Shane	n
Milles, Jeffrey L.	n
Mills, Andrew	n
Milovancevic, Mladen	3a – Nobel Biocare
Mitchell, Ronald	n
Mitchell, Scott A.	n
Moed, Berton R.	1 - Zimmer
Moeller, Amy T.	n
Mohan, Rohith	n
Moisan, Alice	n
Molloy, Robert M.	2, 3b, 5 – Stryker; 5 – Zimmer Biomet
Momaya, Amit M.	n
Momoh, Enesi O.	n
Monroe, Emily J.	n
Montoya-Williams, Diana C.	4 – GlaxoSmithKline, Hologic, Merck, Pfizer
Mooberry, Matthew A.	n
Moor, Molly A.	n
Moore, Chance C.	n
Moore, Allen Ryves	n

Moran, Steven L.	1, 3b – Integra; 3c, 4 – Axogen, Conventus
Moreno, Michael R.	5 – 4Web Medical, Inc.
Moretti, Vincent M.	n
Morgan, Patrick M.	n
Mormino, Matthew A.	n
Morrey, Matthew C.	4 – Tennex Health
Morris, Mark S.	1, 3a – Arthrex, Inc.
Morrison, J. Craig	2 – DePuy, a Johnson & Johnson Company; 2, 5 – Exactech, Inc.
Moussa, Fouad	n
Moutzouros, Vasilios	n
Muh, Stephanie J.	3b – DePuy, a Johnson & Johnson Company, Exactech, Inc.
Mulligan, Ryan P.	n
Muradov, Pavel	n
Murphy, G. Andrew	1, 3b, 5 – Wright Medical Technology, Inc.; 2, 5 – Arthrex, Inc.; 5 – Allostem, Biomimetic, Smith & Nephew; 7 – Saunders/Mosby-Elsevier
Murphy, William G.	3b – Arthrex, Inc.; 3b, 6 – Wright Medical Technology, Inc.; 6 – Smith & Nephew
Murray, Trevor G.	3b – Zimmer Biomet
Murtha, Yvonne M.	n
Nahm, Nickolas J.	n
Nair, Rueben	n
Nam, Denis	3b – KCI, Smith & Nephew, Zimmer Biomet; 4 – OrthAlign Inc.; 5 – EOS Imaging
Nandi, Sumon	n
Narayanan, Shankar	n
Nasr, Kerellos	n
Nassr, Ahmad N.	3c – Vikon Surgical; 5 – AO Spine, Pfizer, Synthes
Navale, Suparna	n
Naveen, Neil B.	n
Nelson, Bradley J.	5 – Histogenics, Zimmer
Nelson, Clay G.	n
Neral, Mithun	n
Netscher, David T.	n
Nho, Shane J.	1, 3b – Ossur; 3b, 5 – Stryker; 5 – Allosource, Arthrex, Inc., Athletico, DJ Orthopaedics, Linvatec, Miomed, Smith & Nephew; 7 - Springer
Nicolozakes, Constantine	n
Nielsen, Paul J.	n
Newman, Jared M.	n
Nicholson, Nathan A.	n
Niedermeier, Steven R.	n
Nikolaus, O. Brant	n
Nixon, Devon C.	n
Noble, Philip	1 – Stryker; 1, 3b, 5 – Zimmer Biomet; 4 – Joint View, LLC; 5 – CeramTec Medical Products, DJ Orthopaedics, MicroPort, Smith & Nephew; 6 – Musculoskeletal Transplant Foundation; 7 - Springer
Noiseux, Nicolas O.	3b – Link Orthopaedics, MicroPort, Smith & Nephew; 5 – DePuy, a Johnson & Johnson Company, Zimmer
Norambuena, German A.	n
Nord, Ashley A.	4 – Johnson & Johnson
Nordhauser, Jennifer	n
Norris, Brent L.	3b – Acumed, LLC, Synthes; 4 – Norris Surgical, LLC; 5 – AONA; 6 - RMD
North, W. Trevor	n
Novak, Kim	n

Nowatzke, Ryan W.	n
Nuber, Gordon W.	4 – Johnson & Johnson
Nuelle, Julia A. V.	n
Nunley, Ryan M.	1, 3b – Microport; 3b – Biocomposites, Blue Belt Technology, Cardinal Health, Halyard, Medtronic, Mirus; 3b, 5 – DePuy, a Johnson & Johnson Company, Medical Compression Systems, Inc., Smith & Nephew; 5 – Biomet, Stryker
Nystrom, Lukas M.	n
O'Hara, Christopher	n
O'Keefe, Regis J.	1 – Fate Therapeutics; 3b – GlaxoSmithKline; 5 – Amgen Co.
Okoroafor, Ugochi C.	n
Okoroha, Kelechi R.	n
Okroj, Kamil	n
Oliphant, Jane E.	n
Oliver, Harvey A.	n
Ollivier, Matthieu	n
O'Neill, Craig A.	n
Onyekwelu, Ikemefuna	n
Oravec, Daniel J.	n
O'Shaughnessy, Maureen A.	n
Osmon, Douglas R.	n
Ostosh, Andrew	n
Otero, Jesse E.	n
Otte, R. Stephen	n
Ozer, Kagan	n
Padley, Michelle A.	n
Pagnano, Mark W.	1 – DePuy, a Johnson & Johnson Company, Stryker; 3b – Pacira Pharmaceuticals
Pallante, Graham D.	n
Pancio, Steven I.	n
Paranilam, Jaya	n
Pardi, Brandon M.	n
Pareek, Ayoosh	n
Park, Nathan	n
Parkes, Chad	n
Parks, Christopher T.	n
Parry, Joshua A.	n
Parvizi, Javad	3b – ConvaTec, Ethicon; 3b, 5 – CeramTec, TissueGene, Zimmer; 4 – Alphaeon, CD Diagnostics, Ceribell, Cross Current Business Intelligence, Hip Innovation Technology, Intellijoint, Invisible Sentinel, Joint Purification Systems, MedAp, MicroGenDx, Parvizi Surgical Innovations, Physician Recommended Nutriceuticals; 4, 7 – Corentec; 5 – 3M, Aesculap/B.Braun, AO Spine, Biomet, Cempra, DePuy, a Johnson & Johnson Company, Integra, Myoscience, National Institutes of Health (NIAMS & NICHD), NDRI, Norvartis, OREF, Orthospace, Pfizer, Rotation Medical, Simplify Medical, Smith & Nephew, StelKast, Stryker, Synthes, Tornier; 7 – Elsevier, Jaypee Publishers, SLACK Incorporated, Wolters Kluwer Health
Patel, Akul	n
Patel, Alpesh A.	1 – Biomet, Ulrich Medical USA; 1, 3b, 4 – Amedica; 3b – DePuy, a Johnson & Johnson Company, Pacira Pharmaceuticals, Relievant, Zimmer; 4 – Cytonics, Nocimed, Vital5; 7 - Springer
Patel, Jay H.	n
Patel, Jay N.	n

Patel, Kushal	n
Patel, Ravi	n
Patel, Rikin	n
Patel, Ronak M.	n
Patron, Laura P.	4 – Amgen Co.; 5 – Precision Spine
Patton, Daniel J.	3b – BESPA GLOBAL, LLC
Pearsall, Albert W.	n
Pearson, Dave	n
Pelle, Dominic W.	n
Peltz, Cathryn D.	n
Perets, Itay	n
Perry, Kevin I.	n
Peter, Logan	n
Petersen, Emily	n
Petersen, Nancy J.	n
Petersen-Fitts, Graysen R.	n
Peterson, Blake E.	n
Pfefferle, Kiel J.	n
Pfeiffer, Ferris M.	n
Pharr, Zachary K.	n
Phillips, Barry B.	2 – Arthrex, Inc.; 7 – Saunders/Mosby-Elsevier
Phillips, Caleb T.	n
Phisitkul, Phinit	3b – Arthrex, Inc., Smith & Nephew; 4 – First Ray, Mortise Medical
Piche, Joshua D.	n
Pinkas, Daphne	4 – Pacira Pharmaceuticals
Pinkston, Christina	n
Pinzur, Michael S.	2, 3b - Stryker
Piponov, Hristo	n
Place, Howard M.	3b – DePuy, a Johnson & Johson Company
Pourzal, Robin	n
Protzer, Lauren	n
Prudhomme, Nickarr	n
Pugely, Andrew J.	n
Purcell, Richard L.	n
Puryear, Aki S.	2 – DePuy, a Johnson & Johnson Company; 2, 3b – Medicrea; 2, 3c – K2M
Pytiak, Andrew	n
Qin, Charles	n
Raines, B. Todd	n
Rajani, Rajiv	3a – Avicenna Media LLC; 4 – Johnson & Johnson, Pfizer
Ramanathan, Deepak	n
Ranade, Arjun	n
Rathjen, Karl E.	4 – Mati Therapeutics; 7 - Elsevier
Ravindra, Amy L.	n
Reams, Megan	n
Reardon, Patrick J.	n
Reed, Lori K.	n
Rees, Harold W.	n
Reif, Taylor J.	n
Ren, Weiping	n
Rhoda, Tammy	n
Richardson, David R.	3b – Extremity Medical, Olympus Medical; 7 – Saunders/Mosby-Elsevier
Ridley, T. J.	n

Rill, Brian K.	n
Rizzo, Marco	n
Roberts, Christopher A.	n
Robins, Andrew	n
Robinson, William A.	n
Roche, Chris	3a, 4 – Exactech, Inc.
Romero, Jose A.	n
Rose, Peter S.	3b – K2M, Inc.
Rosenbaum, Yoseph A.	n
Rosenthal, Brett D.	n
Roth, Matthew F.	n
Rud, Christopher	n
Russo, Scott S.	2 – Medtronic Sofamor Danek; 4 - Micromachines
Ruta, David J.	n
Ryu, Robert	3a – Gilead (sister); 4 - Gilead
Sabatino, Meagan J.	n
Sabbag, Orlando	n
Sabesan, Vani J.	3b – Arthrex, Inc.; 5 – Exactech, Inc.
Sacksteder, Nicholas J.	n
Sacolick, Davidson A.	n
Safadi, Fayez	n
Sahota, Shawn	n
Salata, Michael J.	3b – Smith & Nephew
Salem, Aliasager	n
Salkeld, Samantha L.	4 – Precision Spine
Saltzman, Bryan M.	7 – Nova Science Publishers, Postgraduate Institute for Medicine
Saltzman, Matthew D.	1, 3b – Wright Medical Technology, Inc.; 3b – CareFusion, Medacta
Samuelsen, Brian T.	n
Sanchez-Sotelo, Joaquin	1, 2, 5 – Stryker; 2 – Merck; 3b – Exactech, Inc.; 7 – Elsevier, Journal of Shoulder and Elbow Surgery
Sanders, Thomas L.	n
Sandhu, Kevin P.	n
Savage, Jason W.	3b - Stryker
Scharschmidt, Thomas J.	5 – Millenium Pharmaceuticals
Schiff, Adam P.	3b – Regneration Technologies, Inc., Sonoma, Stryker
Schiffman, Brett A.	n
Schirmers, Joseph D.	n
Schleck, Cathy D.	n
Schlitz, Nicholas K.	n
Schmidt, Andrew H.	1 – Smith & Nephew; 3b – Acumed, LLC, Bone Support AB, St. Jude Medical; 3b, 4 – Conventus Orthopedics; 4 – Epien, Epix VAN, Twin Star Medical; 7 – Thieme, Inc.
Schmidt, Courtney L.	n
Schneider, Andrew M.	n
Schoch, Bradley S.	2 – DJ Orthopaedics
Schroder, Lisa K.	n
Schroeder, Amanda J.	n
Schwartz, Brian E.	3a – Abbott
Schwarzman, Garrett	3a, 4 - Abbott
Scotting, Oliver	n
Seitz, Amee L.	n
Seligson, David	3b – Stryker; 5 – Pacira Pharma; 7 - Springer
Sems, S. Andrew	1, 3b - Biomet
Sershon, Robert A.	n

Seymour, Rachel	n
Shah, Neil S.	n
Shah, Ritesh	2, 3b – Smith & Nephew; 5 – Wright Medical Technology, Inc., Zimmer; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Shah, Sapan H.	n
Shahriar, Rajin	n
Shakir, Irshad A.	n
Shannon, Steven F.	n
Shaughnessy, William M.	n
Shearer, David	n
Sheehan, Joseph	n
Shen, Mary R.	n
Sherman, Seth L.	3b – Neotis, Regeneration Technologies, Inc., Vericel; 3b, 5 – Arthrex, Inc.; 5 - Zimmer
Sherwood, Alexandria J.	n
Shi, Lewis L.	n
Shillingford-Cole, Ventrice	n
Shin, Alexander Y.	1 – Trimed
Shin, Jessica	n
Shofoluwe, Ademola	n
Siccha, Miguel	n
Siebler, Justin C.	n
Sierra, Rafael J.	1, 2, 3b, 5 – Biomet; 3b – Link Orthopaedics; 5 – DePuy, a Johnson & Johnson Company, Stryker, Zimmer
Sikora-Klak, Jakub	n
Sim, Franklin H.	7 – Saunders/Mosby-Elsevier
Simcock, Xavier C.	n
Simoens, Kevin J.	n
Simpson, Jordan	n
Sinatro, Alec M.	n
Sinicrope, Brent J.	n
Skalak, Timothy	2 - Synthes
Slater, Robert R., Jr.	1 – Folsom Surgery Center; 1, 3c – Instrument Specialists, Inc.; 2 – Johnson & Johnson
Slaven, Sean E.	n
Smith, Bradley W.	n
Smith, Brian	n
Smith, Carson	n
Smith, Justin T.	3a – Surgical Devices
Smith, Kevin M.	n
Smith, Langan	n
Smith, Matthew J.	2, 3b, 5 – Arthrex, Inc.; 3b – Zimmer; 5 - Tornier
Smith, Richard A.	n
Sondag, Greg	n
Sorkin, Anthony T.	2, 3b, 4 – Stryker; 4 – Johnson & Johnson
Southam, Brendan	n
Speeckaert, Amy L.	n
Sperling, John W.	1 – Biomet, DJ Orthopaedics; 3b - Tornier
Spiker, Andrea	n
Spinner, Robert J.	3b – Mayo Medical Ventures; 7 – Saunders/Mosby-Elsevier
Sporer, Scott M.	1 – DJO Surgical; 1, 5 – Zimmer Biomet; 3b – DJ Orthopaedics, Osteoremedies, Pacira Pharmaceuticals; 3b, 4 – Pixarbio; 5 – Central Dupage Hospital, Stryker; 7 – SLACK Incorporated
Springer, Bryan D.	1, 3b – Stryker; 2 – CeramTec Medical Products; 3b – Convatec,

	Osteoremedies; 4 – PixarBio; 6 – Joint Purifications systems
Srnec, Jason J.	n
Stafford, Paul R.	6 – AO North America: fellowship program support
Stanfield, Jacob M.	n
Stannard, James P.	3b – Acelity, DePuy, a Johnson & Johnson Company, Nuvasive, Regeneration Technologies, Inc., Smith & Nephew; 3b, 5 – Arthrex, Inc.; 5 – Coulter Foundation, U.S. Department of Defense; 7 - Thieme
Stannard, James T.	n
Statz, Joseph M.	n
Stavrinos, Despina	n
Steeby, Shaun F.	n
Steffensmeier, Andrew M.	n
Steinmann, Scott P.	1, 3b – Arthrex, Inc., Biomet
Stender, Zachary	n
Stern, Peter J.	n
Stewart, Robert J.	n
Stirton, Jacob	n
Stitgen, Michael B.	n
Stoker, Aaron M.	6 – Arthrex, Inc., Synthes
Stone, Aaron	n
Stoodley, Paul	2, 3b, 5 – Biocomposites; 3b – Smith & Nephew; 5 – Philips Oral Healthcare; 6 – Novaflux, Zimmer
Stricklin, Olivia E.	n
Stronach, Benjamin M.	n
Strotman, Patrick K.	n
Stryker, Louis S.	5 - Stryker
Strzepa, Peter	3a – Fellowship of Orthopaedic Researchers, Inc.
Stuart, Michael J.	1, 3b – Arthrex, Inc.; 5 - Stryker
Stuhlman, Casey R.	n
Stulberg, Bernard N.	1, 3b – Exactech, Inc.; 2 – Medtronic, Pacira Pharmaceuticals; 3b – DJ Orthopaedics; 3c – Think Surgical; 5 – Corin USA
Stulberg, S. David	1 – Biomet, Innomed; 1, 2, 3b – Aesculap/B.Braun; 1, 2, 3b, 4 – Stryker; 2, 3b, 4 – Zimmer; 4 – Blue Belt Technologies, Johnson & Johnson; 7 – Peachtree Publishers
Su, Alvin	n
Suleiman, Linda I.	n
Summers, Hobie D.	n
Surma, Tyler J.	n
Sutak, Alan K.	n
Swanson, David	n
Sweet, Matthew C.	n
Swiontkowski, Ellen	7 – Journal of Bone and Joint Surgery – American, Wolters Kluwer Health – Lippincott Williams & Wilkins
Swiontkowski, Marc F.	6 – U.S. Department of Defense – Chair METRC DSMB; 7 – Journal of Bone and Joint Surgery-American, Saunders/Mosby-Elsevier, Wolters Kluwer Health - Lippincott Williams & Wilkins
Tager, David S.	3a - Celgene
Taliaferro, Kevin	n
Tanenbaum, Joseph E.	n
Tatro, Joscelyn M.	n
Taunton, Michael J	1, 3b – DJ Orthopaedics; 5 – DePuy, a Johnson & Johnson Company, Stryker
Taylor, Mathew Z.	n
Tenbrunsel, Troy N.	n

Tennant, Joshua N.	n
Tetreault, Matthew W.	n
Teusink, Matthew J.	6 – DJ Orthopaedics
Thankam, Finosh	N
Thomas, Avis J.	n
Thompson, Kirk M.	n
Throckmorton, Thomas W.	1, 2, 3b, 5 – Biomet; 2, 3b – Zimmer; 4 – Gilead; 7 – Saunders/Mosby-Elsevier
Tibone, James E.	3c – Arthrex, Inc.
Tofte, Josef N.	n
Toftoy, Andrew C.	n
Tollemar, Viktor	n
Tompkins, Marc	6 – Allosource – ROCK Group, Vericel – ROCK Group
Tonnos, Frederick	n
Toohey, John S.	n
Toy, Patrick C.	1 – Innomed; 3b - Biomet
Triplet, Jacob J.	n
Trousdale, Robert T.	1 – Medtronic; 1, 3b – DePuy, a Johnson & Johnson Company
Tubbs, Travis	n
Tucker, Cody	n
Turner, Norman S.	n
Udawatta, Thiran	5 – DePuy, a Johnson & Johnson Company
Unger, R. Zackary	n
Vaidya, Rahul	1 – Smith & Nephew; 1, 2, 5, 6 – Synthes; 2, 3b, 3c – Stryker
Van Demark, Robert E., III	n
Van Dyke, Rufus O.	n
Van Heest, Ann E.	n
Vara, Alexander D.	n
Varadarajan, Kaushik	n
Varma, Vishal	n
Varner, Kevin E.	1, 3b – Solana; 1, 3b, 4 – In2Bone; 4 – Wright Medical Technology, Inc.
Vasileff, Christopher C.	n
Venker, Brett	n
Villa, Jordan C.	n
Villarreal, Arturo D.	n
Villarroel, Leonardo	n
Virk, Sohrab	n
Virkus, Walter W.	2, 3b, 4 – Stryker; 3a - Novartis4 – Johnson & Johnson; 7 – SLACK Incorporated
Volgas, David A.	n
Voos, James E.	3b – Arthrex, Inc.
Wade, Mary Beth E.	n
Wagner, Eric R.	n
Walker, Janet	n
Walsh, John P.	n
Walters, Jordan D.	n
Wan, Jim	n
Wanderman, Nathan R.	n
Wang, Hongmei	n
Ward, Christina M.	n
Warth, Lucian C.	n
Waterman, Brian R.	7 - Elsevier

Watkins, Robert G., III	1 – Medtronic Sofamor Danek; 2, 3b – Aesculap/B.Braun, Amedica, RTI Surgical
Watson, George	n
Watson, J. Tracy	1 – Biomet; 1, 2 – Smith & Nephew; 3b – Acumed, LLC, Bioventus, Nuvasive
Watts, Chad D.	n
Webb, Brad A.	n
Webb, Matthew R.	n
Wechter, John F.	n
Weiner, Joseph A.	n
Weller, William J.	n
Wells, Daniel B.	n
Wera, Glenn D.	n
West, Christopher R.	1, 3b – Linvatec, Mitek
Westburg, Jerald	n
Westermann, Robert W.	n
Weston, John T.	n
Whaley, James	n
Whiting, Daniel R.	n
Wiater, Brett P.	n
Wiater, J. Michael	2 – DePuy, a Johnson & Johnson Company; 2, 3b, 5 – Zimmer; 3b – Biomet; 4 – Eleven Blade Solutions, Inc.; 5 – Synthes, Tornier
Wilhelm, Spencer K.	n
Wilk, Kevin E.	3b – Litecure Laser Company Intelliskin Zetroz, Performance Health; 3c – AlterG; 5 – Intelliskin; 6 – Dynasplint Bauerfeind ERMI Device: Educational Grant; 7 – Churchill Livingstone CV Mosby Slack Publishing
Wilkening, Matthew W.	n
Wilkinson, Brandon G.	n
Willey, Michael C.	5 - Biomet
Williams, Benjamin R.	n
Williams, Brendan A.	n
Wilson, Philip L.	5 – Allosource, Ossur; 7 - Elsevier
Wingerter, Scott A.	n
Winkler, Maxwell L.	n
Winston, Leland A.	n
Wise, Jeremy A.	n
Wittig, Shannon	n
Wolf, Brian R.	3b – CONMED Linvatec; 5 – OREF; 6 – Arthrex, Inc., Smith & Nephew
Woodson, Jeremy R.	n
Woon, Colin	n
Wright, Brennan	n
Wright, Thomas W.	1, 3b, 5 – Exactech, Inc.; 5 – Integra Lifesciences Corporation/Ascension Orthopaedics, Skeletal Dynamics, LLC; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Wu, Hao-Hua	n
Wyatt, Charles W.	n
Wyles, Cody C.	n
Wyrick, John D.	2 – Smith & Nephew; 3b - Stryker
Yakkanti, Ramakanth	n
Yang, King	n
Yassir, Walid K.	n
Yeni, Yener N.	n
Yokhana, Sanar S.	n

Yoon, Patrick	2 – International Congress for Joint Reconstruction; 2, 3b – Arthrex, Inc., Orthofix, Inc.; 3b – Orthofix, Inc., Paragon 28
Young, Grant	n
Young, Porter F.	n
Yuan, Brandon J.	n
Zajac, John	n
Zambrano, Steve	3a, 6 – 4Web Medical, Inc.
Zarling, Bradley J.	n
Zhang, Jingwei	n
Zhu, Andy F.	n
Ziemba-Davis, Mary	n
Zuckerman, Joseph D.	1 – Exactech, Inc.; 3c – Gold Humanism Foundation, J3Personica/Residency Select; 3b – Musculoskeletal Transplant Foundation; 4 – AposTherapy, Inc., Hip Innovation Technology; 7 – SLACK Incorporated, Thieme, Inc, Wolters Kluwer Health – Lippincott Williams & Wilkins
Zvirbulus, Raimonds	n