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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 18, 2018

Is the Prevalence of Ulnar Artery Thrombosis Higher in Orthopedic Surgeons?

Abstract ID: Paper 001

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INTRODUCTION: Ulnar artery thrombosis (UAT), or hypothenar hammer syndrome, has strong correlations with individuals involved in manual labor and various athletic professions. Activities that produce a persistent impact on the hypothenar eminence can damage blood vessels of the hand, specifically the ulnar artery as it passes through Guyon's canal. To our knowledge, the prevalence of these symptoms residing in orthopedic surgeons is unknown. We hypothesized that orthopedic surgeons would have an increased prevalence of UAT than the general population and that this would be true of surgeons who perform a large volume of hip and knee arthroplasty due to frequent use of oscillating saws and methods of retractor placement.

METHODS: 80 current, retired, and resident orthopedic surgeons at two separate institutions were surveyed for symptoms of ulnar artery thrombosis (UAT). Participants completed surveys indicating symptoms of UAT and participation in leisurely activities that may also increase their risk. A timed Allen's test was performed with the radial artery occluded and the time to reperfusion of the hand was measured. A result of >6 seconds to reperfusion was noted as abnormal. The ulnar artery was also dopplered proximal to the wrist flexor crease to ensure proximal patency and flow. Fisher's exact test was used to compare UAT incidence between participants and the general population, and between participant subgroups defined by number of years in practice, subspecialty practice, and volume of arthroplasty cases performed per month.

RESULTS: Ten participants had an Allen's test with reperfusion occurring at >6 seconds. One of these was a false positive with increased Allen's test but no symptoms to indicate pathology.

All participants had positive doppler studies proximal to wrist crease. The incidence of UAT in our study population was 11% (9/80) compared to 1.6% (21/1300) in the general population ($P<0.001$). With resident physicians excluded, the incidence was 16% (9/55). Physicians in practice >15 years had a significantly higher rate of UAT (24%) compared to those who had practiced for <15 years (2%) ($P=0.0030$). The incidence of UAT in adult reconstruction surgeons was 40% (2/5) compared to only 9% (7/75) in other subspecialties, but this was not statistically significant ($P=0.095$).

CONCLUSIONS: Based on the prevalence in this cohort, orthopaedic surgeons are at a greatly increased risk of ulnar artery thrombosis compared to the general population. The risk of ulnar artery thrombosis appears to increase with year of practice and may increase with increased number of arthroplasty cases performed.

Extended Oral Antibiotic Prophylaxis in High Risk Patients Substantially Reduces Primary Total Hip and Knee Arthroplasty 90-Day Infection Rate

Abstract ID: Paper 002

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BACKGROUND: Total joint arthroplasty (TJA) bundled and episodic payment models shift risk and cost associated with periprosthetic joint infection (PJI) to surgeons and hospitals. This causes some to avoid treating high-risk patients, subsequently burdening academic and tertiary care centers. In addition, there is little data that supports optimizing host risk factors preoperatively will subsequently decrease PJI rates, and there is recent data supporting extended oral antibiotic prophylaxis in reimplantation TJA. The study purpose was to evaluate whether extended oral antibiotic prophylaxis can minimize PJI in high-risk primary TJA patients.

METHODS: A retrospective cohort study of 2,260 primary hip and knee arthroplasties from 2011 through 2016 at a suburban academic hospital with modern perioperative and infection-prevention protocols. Beginning January 2015, extended oral antibiotic prophylaxis for 7 days after discharge was implemented for all patients at high risk (diabetes, obesity, autoimmune disease, end-stage kidney disease, etc.) for PJI. All patients diagnosed with PJI within 90 days were identified and statistically compared between groups with $p < 0.05$ statistically significant.

RESULTS: 1350 patients (59.7%) had one or more risk factors for PJI, and 34.7% of the entire cohort was discharged on extended prophylactic antibiotics. The overall 90-day periprosthetic infection rate was 1.5%. Infection rates were 1.1% (9/831) for patients without risk factors, 3.0% (19/641) for high-risk patients without extended antibiotics, and 0.6% (5/788) for high-risk patients discharged on extended antibiotic prophylaxis ($p = 0.001$). The only non-protocol covariate to increase infection rate was use of a peri-articular injection with liposomal bupivacaine ($p = 0.013$).

CONCLUSIONS: In selected patients at high risk for infection after primary TJA, a statistically significant and clinically meaningful reduction in 90-day infection rate can be realized with extended postoperative oral antibiotic prophylaxis. Further study is warranted before widespread adoption to ensure this protocol does not promote antimicrobial resistance and supports appropriate antibiotic stewardship.

Outcomes with Overlapping Surgery at a Large Academic Medical Center

Abstract ID: Paper 003

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BACKGROUND: Overlapping surgery (OS) is the practice of an attending physician providing supervision to two surgeries that are scheduled at overlapping times. Recent media and government attention has raised concerns about this practice and the need for informed patient consent. The purpose of this study was to evaluate the efficiency and safety of Overlapping Surgery at a training institution by comparing it to non-overlapping surgery (NO) with respect to operative time, mortality, readmissions, and complications.

METHODS: A population-based, retrospective, cohort study was conducted using data on inpatient and ambulatory operative procedures from January 1, 2014, to December 31, 2015. Patients who had undergone surgery by attending surgeons who performed 10% or more of their cases overlapping were selected. OS was defined as any portion of a case overlapping with another case by the same surgeon. Additionally, patients were stratified by the surgical specialty of their surgeon. 30-day mortality, readmission within 30 days, and seven patient safety indicators (PSIs) were recorded.

RESULTS: A total of 26,260 and 15,106 cases met our criteria for analysis for surgical time and outcomes, respectively. OS patients had an average case length of 2.18 hours compared to 1.64 hours among NO patients, ($p < 0.0001$), a decreased risk of mortality (relative risk [RR] 0.42, 95% confidence interval [CI] 0.34-0.52, $p < 0.0001$), a decreased risk of readmission (RR 0.92, 95% CI 0.86-0.98, $p = 0.0148$), and a decreased risk of experiencing any PSI (RR 0.67, 95% CI 0.55-0.83, $p = 0.0002$).

SUMMARY: The present study confirms prior reports and addresses gaps in the literature regarding OS, such as the effect of resident involvement and the individual effect of OS in 13 different surgical specialties. The findings highlight the need for additional investigation and suggest that the practice of overlapping surgery does not expose patients to increased risk of negative outcomes.

Use of Closed Incisional Negative Pressure Wound Therapy After Revision Total Hip and Knee Arthroplasty in Patients at High Risk for Infection - A Prospective, Randomized Clinical Trial

Abstract ID: Paper 004

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BACKGROUND: Continuous wound drainage after revision total hip (THA) and knee arthroplasty (TKA) can lead to the development of a periprosthetic joint infection (PJI). Closed incisional negative pressure wound therapy (ciNPWT) has been reported to help alleviate drainage and other wound complications. The purpose of this study was to compare the use of ciNPWT with a silver-impregnated occlusive dressing, in high risk patients who underwent revision THA and TKA. Specifically, we evaluated: (1) wound complications, (2) re-admissions, and (3) re-operations that occurred within 12 weeks of revision THA and TKA.

METHODS: A total of 160 patients undergoing elective revision THA or TKA were prospectively randomized to receive either ciNPWT or a silver-impregnated occlusive dressing after surgery in a single institution. Patients were included if they had at least one risk factor for developing wound complication(s): BMI >35, anticoagulant use other than aspirin, peripheral vascular disease, depression, diabetes mellitus, current smoker, history of PJI, current use of corticosteroids or immunomodulators, current history of malignancy, rheumatologic disease, kidney disease and/or dialysis, malnutrition, liver disease, history of organ transplant, or HIV. Wound complication, re-admission, and re-operation rates were collected at 2, 4, and 12 weeks postoperatively.

RESULTS: There were no significant differences between groups in terms of demographics or perioperative factors, except for septic revisions and the reason for revision. The mean number of risk factors was slightly higher in the controls (2.7 vs. 2.2, $p=0.009$). The rate of any wound complication was significantly higher in the control group compared to the ciNPWT group (22 vs. 9, $p=0.004$). These remained significant at 2, 4, and 12 weeks postoperative. At 2, 4, and 12 weeks postoperatively, there was no significant difference between the control group and the ciNPWT group in terms of any hospital readmission (16 vs. 16, $p=0.99$); however, re-operation rate was higher in the control group, but this did not reach statistical significance (11 vs. 5, $p=0.063$).

CONCLUSION: ciNPWT may decrease the risk of postoperative wound complications in high risk patients after revision THA and TKA.

MAOA BREAKOUT SESSION #1
HAND/ELBOW
April 19, 2018

Radiographic and Clinical Outcomes of Distraction Bridge Plate Fixation for Complex Intra-Articular Distal Radius Fractures

Abstract ID: Paper 006

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HYPOTHESIS: Distraction bridge plate (DBP) fixation for displaced intra-articular distal radius fractures can effectively reconstruct the distal radius with maintenance of acceptable radiographic parameters and restoration of function while allowing patients to begin early weight bearing for activities of daily living (ADL).

METHODS: A retrospective chart review was performed of all intra-articular distal radius fractures that underwent DBP fixation with or without additional fixation methods (e.g., fragment specific fixation, K-wires) at a Level 1 trauma center. Radiographic outcomes were volar tilt, radial height, inclination, and articular step-off measured preoperative, immediately following plate fixation, prior to plate removal, and postoperatively. Clinical outcomes assessed wrist range of motion and pain at final follow-up.

RESULTS: Twenty-three comminuted, intra-articular distal radius fractures were treated with DBP fixation. Additional fragment-specific fixation included implants other than volar locking plates (n=5) or K-wires (n=5). Distraction bridge plates were removed a mean of 95 days (± 33.5 days) from the index procedure. There were significant improvements in intra-articular displacement ($p=0.002$), volar tilt ($p=0.00005$), radial height ($p=0.045$) and inclination ($p=0.001$) from preoperative to post bridge plate removal for patients with unacceptable parameters at mean radiographic follow-up of 124 days (± 146). In all cases, volar tilt was within 5° of neutral or greater (5.5 ± 5.5), radial height 11.3 (± 2.3), radial inclination $20.2 (\pm 4.4)$, and step-off less than 2.0 mm ($0.6 \pm .8$). At a mean clinical follow-up of 11.4 weeks (± 83 days), mean wrist and forearm motion was flexion to 29° , extension to 33° , pronation to 80° , and supination to 61° with an average pain level of less than 1/10 on the pain scale (0.85 ± 1.36). Complications included 1 plate breakage and 1 patient who sustained a fracture proximal to the plate; both over 6 weeks from index surgery.

CONCLUSION: Distraction bridge plate fixation with or without additional fixation methods can be used to effectively reconstruct complex, intra-articular distal radius fractures. Although wrists are immobilized for a prolonged period of time, functional wrist and forearm range of motion can be restored after DBP removal with minimal residual pain. The use of DBP permits early weight bearing to facilitate performing ADLs. Caution must be maintained with early mobilization after DBP fixation to prevent plate breakage and perihardware fractures.

Biomechanical Analysis of Capsular Repair vs. TFCC Ulnar Tunnel Repair for Triangular Fibrocartilage Complex Tears

Abstract ID: Paper 007

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PURPOSE: The purpose of this study was to compare the effectiveness of a peripheral capsular repair to a knotless arthroscopic trans-osseous ulnar tunnel repair in restoring distal radioulnar joint (DRUJ) stability and stiffness in the setting of a massive triangular fibrocartilage complex (TFCC) tear.

METHODS: We obtained eight matched pairs of fresh frozen cadaveric forearms for testing. Each forearm was tested in supination and pronation using 3-D optical tracking devices (NDI Certus) prior to any intervention. Each specimen then underwent a diagnostic wrist arthroscopy and sectioning of the TFCC's deep and superficial fibers. All specimens were then re-tested to assess instability secondary to the tear. The TFCC was repaired with either a peripheral capsular repair (CR) using three 2-0 polydioxanone sutures or a trans-osseous ulnar tunnel repair (TR) using a 2-0 Fiberwire, and then re-tested. Statistical significance was set at $p < 0.05$.

RESULTS: After arthroscopic sectioning of the TFCC, all specimens were unstable with a significant increase in translation and a significant decrease in stiffness. Repair of the TFCC with TR resulted in displacement and stiffness similar to the native tissue. CR specimens were found to have significantly greater displacement and significantly decreased stiffness compared to the intact state.

CONCLUSIONS: Arthroscopic sectioning of the TFCC resulted in DRUJ instability, as measured by stiffness and ulnar translation. TR effectively restored DRUJ stability and demonstrated no significant difference in postoperative stiffness or maximal displacement when compared to the intact specimen in pronation and supination. However, the stiffness and maximal displacement of those specimens undergoing CR continued to be significantly different than the intact state, with increased displacement and decreased stiffness in both supination and pronation.

CLINICAL RELEVANCE: This study provides biomechanical evidence that an arthroscopic ulnar tunnel technique can restore stability to the DRUJ after a massive TFCC tear.

Outcomes and Cost Analysis of Needle Aponeurotomy, Collagenase Injection, and Fasciectomy in the Treatment of Dupuytren's Contracture

Abstract ID: Paper 008

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PURPOSE: The aim of our study was to evaluate demographics, repeat interventions and their associated risk factors, and cost of three common treatments for Dupuytren's contractures, including needle aponeurotomy (NA), collagenase injection, and open fasciectomy.

METHODS: We performed a retrospective review examining a consecutive series of 859 fingers with Dupuytren's contractures treated by a single surgeon from 2005 to 2016 at our institution, including needle aponeurotomy (NA) (n=450), collagenase injection (n=274), and fasciectomy (n=135). We collected basic demographics, presenting contractures, and co-morbidities. Outcomes analyzed included need for repeat intervention overall, as well as multiple (greater than 1) repeat interventions. The average standardized direct medical costs in 2016 inflation-adjusted dollars of the initial treatment episodes were calculated for the three groups.

RESULTS: Demographics were similar between the three treatment groups. The fifth finger was the most commonly affected digit including 45% of the NA, 58% of collagenase, and 48% of the fasciectomy groups. Collagenase had the lowest pre-intervention MCP contracture at 24.5° compared to 33° in the NA group, and 30° for the fasciectomy group (p=0.001), while collagenase had the highest PIP and DIP contractures (46° and 10°), compared to NA (32° and 4°), and fasciectomy (31° and 8°), (p=<0.003).

Collagenase had the highest rate of repeat interventions (37%) compared to NA (26%), and fasciectomy (6%), (p=<0.001). Collagenase also had a higher percentage of fingers needing 2 or more interventions (13%), compared to NA (6%) and fasciectomy (2%), (p=<0.001). In the NA group, the factors leading to repeat interventions included younger age (p=0.03), larger PIP contracture (p=0.02), larger DIP contracture (p=0.047), and use of blood thinners (p=0.049); in the collagenase group younger age (p=0.01) and larger PIP contracture (p=0.001); and there were no significant factors leading to repeat intervention in the fasciectomy group. The standardized costs for initial treatment of a single finger by NA, collagenase, and fasciectomy were \$825, \$4,008, and \$4,812, respectively. Including the costs of all repeat interventions, the cumulative costs of NA, collagenase, and surgery were \$1,694, \$5,903, and \$5,157, respectively.

CONCLUSIONS: Treatment with collagenase resulted in the highest rate of repeat interventions as well as the highest cumulative cost over time. Larger contractures at the PIP joints and younger age at time of initial intervention correlate with both increased rates of repeat interventions as well as cumulative cost in the collagenase and NA groups. Though fasciectomy had the highest initial cost, the costs thereafter were significantly less, owing to the fact that repeat interventions were the lowest in this group.

Long-Term Outcomes of Silicone MCP Arthroplasty: A Longitudinal Analysis of 325 Cases

Abstract ID: Paper 009

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INTRODUCTION: The objective of this study was to examine a large prospective group of patients who underwent metacarpophalangeal (MCP) arthroplasty utilizing silicone prosthesis to characterize long-term outcomes functionally and radiographically, identifying factors which contribute to implant failure.

METHODS: An analysis of 325 consecutive MCP arthroplasties in 113 patients was prospectively collected using an institution's total joints registry over 14 years (1998 -2012). Demographics included average age of 64 years, BMI 25 kg/m^2 , 86% females, 15% with diabetes mellitus (DM), 3% laborers, and 49% involving the dominant extremity. Diagnoses included inflammatory arthritis (n=309), post-traumatic arthritis (n=5), and osteoarthritis (n=11). Of the 325 MCP arthroplasties, 26% were index, 28% middle, 24% ring, 22% small finger.

RESULTS: Of the 325 arthroplasties performed over the 14-year time-period, 62 were excluded for less than 2 years of follow-up. Of the remaining 263 arthroplasties, 21 (8%) patients underwent revision. Complications included 27 dislocations (8%), 7 infections (2%), and 6 intraoperative fractures (2%). The 5-, 10-, and 15-year survival rates free from revision were 98%, 95%, and 95%, respectively. The risk for revision was increased in patients with post traumatic arthritis ($p=0.01$), though no other significant risk factors were identified. Of the 325 arthroplasties, a minimum of 2 years radiographic follow-up was available for 214. The 5-, 10-, and 15-year survival rates free from radiographic implant fracture were 93%, 58%, and 35%, respectively. The 5-, 10-, and 15-year survival rates free from coronal plane deformity $>10^\circ$ were 81%, 37%, and 17%, respectively. A diagnosis of post-traumatic arthritis, osteoarthritis, and age were associated with increased risk of radiographic fracture and coronal plane deformity $>10^\circ$. In revision-free patients, at a mean follow-up of 7.2 years, patients had significant improvements in pain level ($p=0.03$), as well as MCP arc of motion from 33° to 43° ($p<0.001$). Neither implant fracture, nor coronal plane deformity $>10^\circ$ had significant association with pain level or arc of motion.

DISCUSSION AND CONCLUSION: MCP arthroplasty using a silicone implant demonstrates excellent 5-, 10-, and 15-year survival rates with a relatively low rate of complications. While coronal plane deformity and radiographic evidence of implant fracture increase substantially over time, these do not result in worse functional outcomes. Overall, patients experience predictable pain relief and improvement in range of motion though silicone implants do not appear to protect from progression of coronal plane deformity and have a high fracture rate.

SUMMARY: MCP arthroplasty with silicone implant has excellent long-term survival, predictable pain relief, and improvement in motion, despite high fracture rate and poor maintenance of coronal plane alignment.

Early Experience with a Radial Head Prosthesis at a Single Institution

Abstract ID: Paper 010

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BACKGROUND: Radial head arthroplasty is a reliable treatment option for treatment of non-reconstructable radial head fractures. The purpose of this study was to evaluate early radiographic outcomes of a radial head arthroplasty system in its first 3 years of use.

METHODS: Twenty-two consecutive patients underwent radial head arthroplasty with a press-fit radial head prosthesis between January 2013 and December 2015. A retrospective review of radiographs was performed to assess for implant loosening and stress shielding.

RESULTS: Radiographs were reviewed at an average of 8.7 months (range 1.5-26). Twenty patients, 32-74 years of age, were available for follow-up. Eleven short stem and 9 long stem prostheses were implanted. Radiographic follow-up of short stem prostheses showed 91% loosening and 0% stress shielding, while the long stems demonstrated 33% loosening and 67% stress shielding.

CONCLUSIONS: The short stem radial head prostheses result in very high rates of periprosthetic loosening, while the long stem had loosening rates similar to other press fit designs. Based on these findings, we do not recommend use of this non-anatomic, press-fit short stem prosthesis. Further clinical studies should be performed to validate the use of the long stem prosthesis.

Fracture Gap Reduction with Variable Pitch Headless Screws

Abstract ID: Paper 011

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INTRODUCTION: Fully-threaded variable-pitch headless screws are used in many settings in surgery and have been extensively studied in this context, especially in regard to scaphoid fractures. However, it is not well understood how screw parameters such as diameter, length, and pitch variation, as well as technique parameters such as depth of drilling, affect fracture gap closure.

MATERIAL AND METHODS: Two fully-threaded variable-pitch headless screws of various diameters (Standard, Mini and Micro) and lengths (16-28 mm) were inserted into polyurethane blocks of normal and osteoporotic densities using a custom jig. Three drilling techniques (drill only through first block, 4 mm into second block, or completely through both blocks) were used. During screw insertion, fluoroscopic images were taken and later analyzed to measure fracture gap reduction. The effect of backing the screw out after compression was evaluated. ANOVA and post-hoc student's t-test were performed to evaluate statistical significance ($p=0.05$).

RESULTS: Drilling at least 4 mm past the fracture site reduces distal fragment push off compared to drilling only through the proximal fragment. There were no statistically significant differences in fracture gap closure in normal versus osteoporotic bone. The Micro screw had a smaller fracture gap closure than both the Standard and Mini screws. Longer screws can achieve a greater fracture gap reduction. The overall fracture gap reduction achieved correlated with the number of threads in the far fragment. After fragment contact and compression with two subsequent full forward turns, backing the screw out by only one full turn resulted in gapping between the fragment blocks.

CONCLUSIONS: Fully-threaded headless variable-pitch screws can only obtain compression between bone fragments if the initial bone gap is less than the fracture gap closed. Final closure may be affected by drilling technique, screw size, and screw length. Fragment compression may be immediately lost if the screw is reversed. In summary, we describe characteristics of variable pitch headless screws that may assist the surgeon in screw choice and method of use.

Proximal Interphalangeal Joint Arthroplasty with the Surface Replacing Arthroplasty Implant; A Comparison of Etiologies

Abstract ID: Paper 012

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HYPOTHESIS: There is a lack of literature examining the utilization of the surface replacing arthroplasty (SRA) prosthesis in the treatment of proximal interphalangeal (PIP) joint arthritis. The purpose of this study was to assess the SRA results PIP arthroplasty utilizing the SRA implant for various etiologies.

METHODS: We performed a review of 91 primary SRA PIP arthroplasties in 56 patients from 1998 to 2012. The mean age at surgery was 61 years, BMI 28, with 63% involving the dominant extremity, 81% females, no smokers, no laborers, and 5% with diabetes mellitus (DM). There were 23 patients with inflammatory arthritis, 53 with osteoarthritis (OA), and 15 with post-traumatic arthritis. The following are patient characteristics between the inflammatory arthritis, OA and post-traumatic groups: age (59, 66, 51), females (91%, 83%, 60%), and DM (4%, 8%, 0%).

RESULTS: There were 16 revision surgeries performed at a mean 1.5 years postoperatively, including 4 in patients with inflammatory arthritis, 10 with OA and 2 with post-traumatic arthritis. The 2-, 5-, and 10-year survival rates were 86%, 80%, and 80%, respectively. The 5-year survival rates for the inflammatory arthritis, OA, and post-traumatic arthritis were 83%, 77%, and 84% ($p=0.78$), respectively. Postoperative complications include 3 dislocations, 4 infections, 6 cases of heterotopic ossification, and 1 postoperative fracture. There were no significant differences in the rate of complications between the surgical indications. In unrevised arthroplasties, at a mean 6.3 years (2-12) follow-up, there was a significant improvement in the preoperative to postoperative pain levels ($p<0.01$), but no significant difference in the preoperative to postoperative total arc of PIP motion, grip strength or pinch strength. There was no significant difference in total arc of motion between those with inflammatory arthritis, OA, and post-traumatic arthritis.

SUMMARY POINTS: The SRA implant in PIP arthroplasty is associated with reasonable medium-term survival and relatively low complications, regardless of surgical indication. Patients experience predictable pain relief and preservation of the PIP motion. SRA implants represent an alternative to silicone in patients with PIP joint degeneration.

Thirty-Six Year Clinical and Radiographic Follow-Up of Preaxial Polydactyly Reconstruction

Abstract ID: Paper 013

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BACKGROUND: The long-term clinical and radiographic results of preaxial polydactyly reconstruction are unknown. We hypothesize that patients will have functional limitations as adults, decreased strength and range of motion, and radiographic signs of arthritis on x-rays.

METHODS: Patients having preaxial polydactyly reconstruction 15-60 years ago completed patient-reported outcomes measures including the Disabilities of the Shoulder and Hand (DASH), DASH Work, DASH Sports, and the Patient-Reported Outcomes Measurement Information System (PROMIS) Upper Extremity Computer Adaptive Test (UECAT). Additionally, patients were invited to our institution for clinical and radiographic evaluation. Aggregate patient reported outcomes scores were compared to the general population. Pinch strength, side pinch strength, and grip strength testing were compared to the contralateral extremity. Range of motion of the interphalangeal joint and the metacarpophalangeal joint were completed using a goniometer. The t-test was used to compare means for strength and range of motion compared to the contralateral extremity.

RESULTS: Twenty-five patients with 27 reconstructed thumbs completed patient-reported outcomes questionnaires, and 11 patients with 13 reconstructed thumbs completed clinical and radiographic evaluation. The median follow-up for the cohort was 36 years. The most common type was a Wassel-Flatt IV. The mean DASH score was 3.7, similar to the general population mean of 10.1 (14.5 SD). The mean PROMIS Upper Extremity CAT score was 51.5 (population mean 50; 10.0 SD). The mean DASH work module was 0.9 and the mean DASH sports module was 0. The mean pinch strength, side pinch strength, and grip strength did not differ significantly from the contralateral extremity controls. Interphalangeal joint range of motion was 27°, significantly less than the contralateral range of motion of 80° ($p < 0.001$). No patient had significant pain in the thumb or the hand. A minority of patients developed interphalangeal joint arthritis (15.4%), and each of these patients had significant angular deformity. Nearly half of patients, 46.2%, had greater than 10° of angular deformity.

CONCLUSIONS: Preaxial polydactyly patients treated with reconstruction have similar functional outcomes compared to the general population as measured on the DASH, DASH Work, DASH Sports, and PROMIS UECAT. Patients have decreased range of motion at the interphalangeal joint and maintained strength. Arthritis was seen in 15% of patients, but was not associated with pain. Angular deformity developed in nearly half of patients, and warrants follow-up into adulthood for consideration of surgery.

Matti-Russe Technique for Scaphoid Nonunions in Pediatric Patients

Abstract ID: Paper 014

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PURPOSE: To evaluate the long-term clinical and radiologic outcomes after surgery for scaphoid nonunion using the Matti- Russe technique in the pediatric population.

METHODS: A retrospective review was performed on pediatric patients, defined as less than 18 years of age, with a scaphoid nonunion that were treated with the Matti- Russe technique. This technique consisted of open reduction with intercalated bone graft and no internal fixation. Union was determined by radiographs and/or computed tomography, with bony bridging present in at least 50%. [1]. Intrascaphoid, scapholunate, and radiolunate angles were calculated. We reviewed wrist range of motion and complications.

RESULTS: There were 10 patients who underwent the Matti-Russe technique. The average age was 14.7 years old (range: 13-17). All 10 of these patients had a scaphoid waist nonunion. There were 9 males and 1 female with an average follow-up of 13 months. The average amount of time to surgery from the date of injury was 12.3 months. All 10 patients went on to radiographic union at or before 6 months from surgery. Preoperative intrascaphoid, scapholunate, and radiolunate angles were 29°, 62°, and 20°. Postoperative intrascaphoid, scapholunate, and radiolunate angles improved to 16°, 38°, and 10° which was significant ($p < 0.05$). All 10 patients had improved wrist range of motion from preoperative visit and 9 out of 10 had equal to contralateral wrist range of motion. There were no associated complications or reoperations.

CONCLUSION: The Matti-Russe technique is a safe and effective treatment for scaphoid nonunion in the pediatric population. It facilitates scaphoid union without the need for internal fixation.

Level of Evidence: level IV, retrospective case series

Characteristics of Hand Transfer Patients and Follow-Up Appointment Based on Insurance Status

Abstract ID: Paper 015

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INTRODUCTION: The transfer of patients for hand and microsurgical care from emergency departments (ED) to tertiary care centers is a practice that requires substantial resources. It is often suggested that the patient's insurance status plays a role in likelihood of transfer. Many of these transferred patients may not require immediate surgery in the operating room (OR), but undergo procedures in the ED. They are then discharged with instructions for follow-up care with a hand specialist. Treating surgeons are usually concerned that effective follow-up care is available. This is particularly true for patients with complex hand injuries. This study analyzed patients with hand injuries or conditions acutely transferred to an ACS Level 1 trauma center to determine whether there was a correlation between the patient's insurance coverage and the likelihood of outpatient follow-up care with a hand specialist.

METHODS: After obtaining institutional review board approval, a retrospective chart review was performed in all patients transferred over a 12-month period to a university ACS Level 1 trauma center for hand and microsurgical trauma care. Collected data includes timing of patient transfer, demographics, insurance status, diagnosis and co-morbidities, procedures performed, disposition, and status of outpatient follow-up. Statistical analysis was performed to determine whether follow-up with a hand specialist was influenced by insurance status.

RESULTS: Over a 12-month period, a total of 83 hand or microsurgical patients were transferred to our trauma center. Thirty percent of transferred patients were confirmed uninsured while 22% of the patients were confirmed to be insured but out of the institution's network. The uninsured patients were less likely to require admission for acute surgery by a hand specialist (36% uninsured versus 62% insured, $p < 0.05$). All discharged patients were provided instructions for outpatient follow-up with the institution's hand specialists. However, 36% of the uninsured and 35% of the out-of-network patients who underwent a procedure in the ED or had acute surgery in the OR did not receive follow-up care by the institution's hand specialists, while only 5% of "in network" insured patients ($p < 0.05$) failed to attend follow-up appointments with medical center surgeons.

CONCLUSION: This analysis demonstrates that uninsured patients are more likely than insured patients to be transferred with issues that can be treated in the ED. Uninsured and out of network patients are less likely to follow-up with health system surgeons than patients with "in network" insurance.

Does the Use of Live Video Evaluations as Part of a Novel Telemedicine Program Alter the Need for Transfer for Management of Acute Hand Trauma?

Abstract ID: Paper 016

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HYPOTHESIS: The use of video evaluation as part of the Arkansas Hand Trauma Telemedicine Program (AHTTP) will not significantly impact the need for transfer for management of acute hand injuries.

METHODS: The AHTTP began on January 1, 2014, and provides continuous availability of a fellowship-trained hand surgeon for telemedicine consultation of acute hand injuries. Evaluations occur in real time utilizing a tablet computer and live video from emergency rooms across Arkansas. In some cases, live video is not available and consultation occurs via telephone. Radiographs are also available for review. On call physicians make recommendations for patient care including local management, transfer for general orthopedic care, or transfer for hand specialty care.

We collected data from 2014 on the use of video evaluation versus telephone consultation. We recorded the need for transfer and the type of transfer (orthopedic or hand surgery). A chi-squared test was used to compare the rate of transfer for video encounters and telephone consultations as well as to compare the rates of transfer for orthopaedic versus hand surgery care.

RESULTS: A total of 298 telemedicine consultations occurred in 2014. Local care was recommended in 164 (55%) cases and transfer in 134 (45%) cases. 195 (65%) evaluations utilized video, while 103 (35%) consultation occurred via telephone. Of the 195 video evaluations, 104 (53%) were recommended for local care. The remaining 91 (47%) cases required transfer including 39 for orthopedic and 52 for hand specialist care. 60 (58%) cases of telephone evaluation were recommended for local care, while the remaining 43 (42%) cases required transfer. 20 consults were transferred to a hand specialist, and 23 were transferred to an orthopedist. The use of video evaluation did not significantly impact the need for transfer ($p=0.42$). Additionally, there was not a significant effect on the rate of transfer for general orthopedic or hand specialist care ($p=0.25$).

SUMMARY: The use of a telemedicine program can minimize unnecessary transfer for care of traumatic hand injuries as local care was recommended for the majority of consultations. Communication with a fellowship trained hand surgeon by telephone or live video are both successful means at preventing unneeded transfers. The use of video evaluations did not alter the rate of transfer to a higher level of care for the management of acute hand injuries. Additionally, the use of live video evaluations did not decrease the rate of transfer to a hand specialist for care.

MAOA BREAKOUT SESSION #2
SPORTS MEDICINE
April 19, 2018

Return to Work and Return to Activity Levels After Multiligament Knee Injury

Abstract ID: Paper 017

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INTRODUCTION: Knee dislocations are severe injuries that can result in significantly decreased patient function. The purpose of this study was to examine long-term outcomes of patients with multiligament knee injuries requiring surgical treatment and to correlate return to work and return to activity times and levels with the number of ligaments involved.

METHODS: A retrospective review of 357 multiligament knee injuries in 346 patients over a 12-year period was performed. Patients with two or more ligaments requiring surgical repair or reconstruction were included in the study. Chi square and ANOVA were performed for data analysis.

RESULTS: The average age at time of injury was 34.7 years (14-70), with 68% being male. Follow-up averaged 35.2 months. Average return to work time was 18.2 months (two ligaments=19.0 months, three ligaments=17 months four ligaments=18.1 months). Average return to activity time was 20 months (two ligaments=20.3 months, three ligaments=19.9 months, four ligaments=20.5 months). There were no significant differences in return to work time ($p=0.75$) and return to activity time ($p=0.99$). In the two ligament group, 80.4% (82/102) returned to full duty, 3.9% (4/102) returned to light duty, and 15.7% (16/102) were unable to return to work. In the three ligament group, 76.0% (92/121) returned to full duty, 8.3% (10/121) returned to light duty, and 15.7% (19/121) were unable to return to work. In the four ligament group, 81.3% (39/48) returned to full duty, 8.3% (4/48) returned to light duty, and 10.4% (5/48) were unable to return to work ($p=0.75$). Return to activity level status was as follows; two ligaments: 60% (60/100) returned to their previous level and 40% (40/100) returned to a level less, none were unable to resume activity. In the three ligament group, 59.0% (72/122) returned to their previous level, 39.3% (48/122) returned to a level less, and 1.6% (2/122) were unable to resume activity. In the four ligament group, 70% (35/50) returned to their previous level and 30% (15/50) returned to a level less, none were unable to resume activity ($p<0.008$).

CONCLUSIONS: Patients with multiligament knee injuries have good return to previous levels of function after surgical management. The number of ligaments requiring surgical management did not significantly affect overall time to return to work, level of return to work, or time to return to activity. Patients with more ligaments requiring surgical management returned to final activity levels similarly to those with less ligaments involved.

Concussions in Soccer: Is Heading Safe?

Abstract ID: Paper 018

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INTRODUCTION: As the popularity of youth soccer is increasing in the U.S. and awareness surrounding concussion injuries is increasing; there has been debate surrounding whether or not heading should be disallowed from play. There is little evidence examining just how often heading has resulted in severe concussion injuries. In order to assess whether or not heading should be allowed, we examined incidence and disposition of concussions occurring from various types of contact related to soccer.

METHODS: The National Electronic Injury Surveillance System (NEISS) was used to collect data on concussion injuries occurring during soccer in pediatric patients (5-18 years old) from 2008 to 2016. Soccer-related concussion injuries were identified using specific codes (1267) and analyzed for variation in disposition over each year. Type of contact was categorized into player to player, head to ball, player to post, and player to ground. A sub-analysis of hospitalized patients was conducted to identify most common types of contact related to hospitalization.

RESULTS: A weighted total of 3,285 soccer related concussion injuries were identified during study period. There was no difference in prevalence seen between males and females and the average age for the cohort was 13.5 years old. The incidence of concussion injuries increased over the study time period but the number of hospitalizations for concussion injuries decreased over the study period ($r = -0.574$), and decreased significantly from prior to 2014 to post 2014 ($p < 0.001$). Sub-analysis of hospitalized patients demonstrated 13% of hospitalizations were due to head to ball contact and 39% and 44% were due to player-player contact and head to ground contact, respectively. Relative Risk of hospitalization from a concussion due to head to ball contact was 7.06 and hospitalization from a concussion due to head to ground contact was 22.60.

CONCLUSION: Due to a minimal amount of severe concussion injuries resulting from player to ball contact; it would seem that no rule change limiting heading the ball is necessary and head to ball contact is generally safe. In addition, it may be more prudent for soccer officials to consider further limitations to player-player contact and playing surfaces as these types of contact seem to result in more severe concussions.

Low Combined Readability Assessment of Orthopedic Sports Medicine Patient Education Materials and Opportunities for Improvement

Abstract ID: Paper 019

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Previous studies have shown that patient education materials in orthopedic surgery are too difficult for patients to read and comprehend. The purpose of this study was to determine whether sports medicine-related patient education material offered by American Academy of Orthopaedic Surgeons (AAOS) and American Orthopaedic Society for Sports Medicine (AOSSM) is written at the 6th-7th grade level recommended by National Institutes of Health (NIH) and explore avenues for improvement.

Online sports medicine patient education materials were downloaded from AAOS and AOSSM and analyzed using Readability Studio Professional Edition per the software instructions. The readability scores were compared to the NIH-recommended grade level of 6.5. Additionally, the software analyzed sentence and word structure.

A total of 153 articles were found via Internet search, 39 from AOSSM and 114 from AAOS. Readability scores expressed in grade level (mean \pm standard deviation) were 11.5 ± 1.4 , 9.9 ± 1.7 , 9.2 ± 2.2 , 11.1 ± 0.6 , 11.1 ± 2.7 , 11.3 ± 1.6 , 11.3 ± 2.5 , 11.7 ± 1.2 , and 9.4 ± 1.8 for Coleman-Liau Index, New Dale-Chall reading level formula, Flesch-Kincaid grade level, FORCAST, Fry Graph, Gunning-Fog Index, Raygor Readability Estimate, Simple Measure of Gobbledygook, and Automated Readability Index, respectively. All scores were significantly higher than the NIH-recommended reading level of 6.5 ($p < 0.05$). Additionally, the articles contained $17\% \pm 3.5$ and $38\% \pm 4.1$ of complex (>3 syllables) and long words (> 6 characters), respectively. Across all scales, AAOS literature had significantly lower reading grades compared to those from AOSSM as well as use of complex (16.3% vs. 19.6%) and long words (37.2% vs. 41.4%) ($p < 0.05$). AAOS literature also had a significantly lower longest sentence length (32.9 vs. 35.6 , $p < 0.05$).

Our study indicates that sports medicine patient education materials from AAOS and AOSSM may be too complex for patients to read and understand. Simplifying words and sentence structure may help in improving readability and ultimately patient education.

Incidence and Surgical Intervention of Symptomatic Discoid Meniscus: An 18-Year Population-Based Study

Abstract ID: Paper 020

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BACKGROUND: Symptomatic lateral discoid meniscus is a rare orthopedic pathology, and therefore information in the literature is limited to small case series. The purpose of this study was to (1) evaluate the incidence of symptomatic discoid meniscus in a geographic population and (2) describe the rate of surgical treatment.

METHODS: The study population included 79 individuals identified through a multi-disciplinary geographic cohort county database who were diagnosed with symptomatic discoid meniscus between 1998 and 2015. The complete medical records were reviewed to confirm the diagnosis and to evaluate details of injury and treatment. Age- and sex-specific incidence rates were calculated and adjusted to the 2010 United States population.

RESULTS: The overall age- and sex-adjusted annual incidence of symptomatic discoid meniscus was 3.2 (95% CI: 2.5, 3.9) per 100,000 person-years. 12.6% of the patients in the cohort had bilateral symptomatic discoid menisci. The overall annual incidence was similar between males (3.4 per 100,000 person-years) and females (2.8 per 100,000 person-years). The highest incidence of discoid meniscus occurred in adolescents males aged 15-18 years (18.8 per 100,000 person-years). 72.2% of patients presented with a symptomatic discoid meniscus tear. Sixty patients (75.9%) received surgical treatment during the study period, including 25 (41.7%) patients who underwent partial lateral meniscectomy, 24 (40%) patients who underwent lateral discoid meniscus saucerization, and 11 (18.3%) patients who underwent lateral meniscal repair.

CONCLUSION: With an overall annual incidence of 3.2 per 100,000 person-years, symptomatic discoid meniscus is a rarely encountered orthopedic injury. However, the incidence of symptomatic discoid meniscus is much higher in adolescent males. Due to the high rate of symptomatic meniscal tears at presentation, the majority of patients are treated surgically.

Study Design: Retrospective case series; Level of evidence III

Key Words: Discoid meniscus, meniscus tear, surgical treatment, incidence

No Difference in Failure Rates Between Hybrid Grafts Compared with Hamstring Autografts in ACL Reconstruction

Abstract ID: Paper 021

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BACKGROUND: Hamstring autografts in ACL reconstruction have been shown to have higher rerupture rates when graft diameter is <8 mm. In the event that an autograft yields <8 mm, augmentation with allograft creates a hybrid with increased diameter. Clinical outcomes of this hybrid graft are not established. Previous studies have demonstrated increased failure rates of hybrid grafts when compared to isolated hamstring autografts and inferior patient reported outcomes.

OBJECTIVE: Assess outcomes and failure rates of an adult population undergoing augmentation with allograft compared to patients with hamstring autograft.

METHODS: A retrospective chart review of primary ACL reconstructions performed by 3 sports fellowship-trained surgeons at a single institution between 2010-2015 identified 20 patients with hamstring autografts with allograft augmentation. A comparison group of 20 patients consisted of patients who underwent ACL reconstruction with hamstring autograft of >8 mm diameter was selected. Graft failure was defined as revision ACL reconstruction or evidence of graft failure on clinical exam or MRI. International Knee Documentation Committee, Marx Activity, and Knee injury Osteoarthritis and Outcome scores were obtained. Patients were contacted to obtain information about outcome score, revision procedures, return to sport, and complications. Eighteen patients in each group were available for a minimum of 2 year follow-up.

RESULTS: Thirty-six patients met criteria for inclusion in this study, 18 in the hybrid group and 18 in the autograft group. Average age in the hybrid group was 28.7 consisting of 8 male and 10 female, and the average age of the autograft group was 28.7 consisting of 13 male and 5 female. No differences were found between group with regards to age or gender. The failure rate was 11% (2 of 18 patients) in the hybrid group and 6% (1 of 18 patients) in the autograft group ($p>.05$). The average IKDC for hybrid group was 74.2 compared to 67.2 in the autograft group ($p>.05$). The average KOOS score of the hybrid group was 67.7 vs. 85.0 in the autograft group ($p< 0.05$). In terms of return to sports, 12/18 (66%) of the hybrid group and 16/18 (89%) in the autograft returned to their sport ($p>0.05$). Only one in the hybrid group required revision surgery for any reason compared to zero in the autograft group.

CONCLUSIONS: In an adult population, allograft augmented hybrid ACL grafts showed no statistically significant difference compared to hamstring autograft in graft failure rates. The autograft ACL group demonstrated a higher KOOS score though the IKDC was equivalent.

Current Postoperative and Return to Play Practices after Anterior Cruciate Ligament Reconstruction by Fellowship-Trained Sports Surgeons

Abstract ID: Paper 022

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INTRODUCTION: Advances in reconstruction and fixation techniques in anterior cruciate ligament (ACL) reconstruction have allowed for many advances in the postoperative management of ACL reconstructions. Although some trends in postoperative management have been accepted, there is no standardized protocol for immediate postoperative management or return to play.

METHODS: Electronic surveys were distributed to sports fellowship-trained orthopedic surgeons from 4 large alumni networks. Demographic information included years of practice and number of ACLs performed per year. Postoperative questions included immediate weight-bearing status, brace use, and continuous passive motion (CPM) use. Return to play questions included time frame for return to play, brace use with return to play, and metrics used for clearance to sport.

RESULTS: A total of 143 sports fellowship surgeons completed the survey. The average years in practice were 15.1 years (0.5-46 years). The average number of ACL reconstructions performed per year was 20-50 in 44% (63/143) and 50-100 in 29%. Immediate full weight-bearing was allowed in 91% (130/143) of respondents. CPM was used after surgery in 26% (37/143) used with all patients, 8% (12/143) used only if concomitant meniscal or cartilage repair, and 66% (94/143) not at all. Bracing after surgery was used in 84% (120/143) of respondents and 48% (69/143) requiring after return to play. Return to play was allowed at 6-9 months in 67% (96/143) of respondents and overall 94% (135/143) from 6-12 months. A combination of return to play metrics were used with the most important metric being the hop test followed by specific time point after surgery, with biodex testing being the least important metric for return to play.

DISCUSSION AND CONCLUSION: Immediate weight-bearing after surgery is commonplace for most surgeons with intermittent CPM use. Bracing is quite common immediately postoperatively as well as half the time with return to play. Typically, return to play is allowed after at least 6 months with some form of functional testing and timing from surgery being most important metrics for allowing return to play.

Posterior Capsule Injection of Local Anesthetic for Postoperative Pain Control After Anterior Cruciate Ligament Reconstruction: A Prospective, Randomized Trial

Abstract ID: Paper 023

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INTRODUCTION: To compare femoral nerve block (FNB) only vs. FNB with posterior capsule injection (PCI) of the knee for pain control in patients undergoing anterior cruciate ligament (ACL) reconstruction.

METHODS: Patients undergoing primary ACL reconstruction were randomized to receive either FNB only or FNB with PCI. Following surgery, patients pain was evaluated in the postoperative case unit (PACU) and at home for four days. Pain levels were measured via visual analog scale (VAS) and calculating opioid consumption. Outcomes of interest included postoperative pain levels and opioid consumption.

RESULTS: A total of 42 patients were evaluated, with 21 patients randomized to each study arm. Outcomes showed significant pain reduction in both anterior and posterior knee VAS scores in those that received PCI (anterior VAS: 39.6 vs. 21.3, $p<0.01$; posterior VAS: 25.4 vs. 15.3, $p=0.01$). Moreover, the PCI group also showed significantly less opioid consumption compared to FNB only (23.5 pills vs. 17.4 pills, $p=0.03$). There were no differences found in pain scores between groups in home VAS scores.

DISCUSSION AND CONCLUSION: Our finding suggest the use of arthroscopically-assisted injection of local anesthetic to the posterior capsule of the knee significantly reduces early postoperative pain and dramatically reduces the number of opioid medication taken after ACLR.

The Second Fracture: Is Treatment Necessary with Combined ACL Reconstruction?

Abstract ID: Paper 024

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INTRODUCTION: There is a paucity of clinical information to guide treatment of a combined anterior cruciate ligament (ACL) tear and a Second fracture. The purpose of this study was to compare clinical outcome, graft failure rate, and activity level between ACL reconstruction patients with and without an untreated Second fracture at a minimum 2-year follow-up.

METHODS: This retrospective matched-cohort study included a group of patients with combined ACL tear/untreated Second fracture matched, based on age, gender, BMI, and graft-type, to a control group of patients with an ACL tear and no Second fracture. All patients were treated with ACL reconstruction (ACLR) alone between the years of 2000 and 2015. The diagnosis of Second fracture, or bony avulsion of the anterolateral complex (ALC), was made by radiographic analysis in all cases. Data regarding initial injury, surgical intervention, and physical examination findings were recorded. Clinical and functional outcomes were obtained using physical examination, IKDC subjective scores, and Tegner activity levels.

RESULTS: Twenty patients (16 M:4 F) with combined ACL tear/untreated Second fracture with an average age of 26.3 (13-44) were matched to the control group of 40 patients (32 M:8 F) with ACL tear and no Second fracture with an average age of 26.4 (13-47). The study group was followed for a mean of 59.1 (24-180) months and the control group for a mean of 55.5 (24-120) months. The IKDC score mean was 86.5 (54-100) for the study group compared to 93.0 (54-100) for the control group ($p=0.03$). The graft rupture rate was 10% for both groups ($p=0.97$). Mean time to rupture was 33.0 (21-45) months in the study group and 63.5 (39-88) months in the control group. There was no significant difference between the two groups in regards to postoperative pivot shift testing ($p=0.61$) or median Tegner activity level (median = 6).

DISCUSSION AND CONCLUSION: At mid-term follow-up, ACL reconstruction patients with and without a Second fracture had similar pivot shift exam, graft failure rate, and activity levels. IKDC scores were statistically worse in the patients with combined ACL tear/untreated Second fracture, but the difference was less than the minimal clinically important difference for IKDC scores. These findings suggest that patients with combined ACL tear/untreated Second fracture can have comparable outcomes to patients with ACL tear and no Second fracture when treated with ACLR alone.

Anterolateral Ligament Reconstruction Practice Patterns Across the United States

Abstract ID: Paper 025

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BACKGROUND: Anterior cruciate ligament (ACL) reconstruction has been shown to have good outcomes. However, some patients that undergo the procedure still experience instability of the knee joint and are unable to return to their normal level of activity. The anterolateral ligament (ALL) has been reported to add translational and rotational stability to the knee joint. The purpose of this study was to survey orthopedic surgeons to determine the current state of practice with regards to ALL reconstruction.

METHODS: 137 orthopedic surgeons nationwide were surveyed through an online survey. A 7-question survey assessed surgeon experience, indications, technique, graft choice, and postoperative rehabilitation when performing ALL reconstructions.

RESULTS: Surveys were completed by 119 surgeons in the United States, a response rate of 86.86%. Of those that responded, 37.9% perform ALL reconstruction/lateral extra-articular tenodesis in conjunction with ACL reconstruction. Grade III pivot shift and revision ACL reconstruction were the most common indications for ALL reconstruction. 60.4% use the "anatomic" ALL reconstruction with hamstring method for this procedure. 60.92% of responders reported that they perform ALL reconstruction in less than 10% of ACL reconstruction surgeries. 87.5% stated that postoperative rehabilitation is the same if an ALL reconstruction or LT is performed with ACL reconstruction.

DISCUSSION: Despite the recent surge in literature surrounding ALL reconstruction, the majority of orthopedic surgeons surveyed do not perform ALL reconstruction or lateral extraarticular tenodesis with ACL reconstruction. Most surgeons perform ALL reconstruction on patients with a grade III pivot shift or on patients undergoing revision ACL reconstruction; however, we did not find a consensus regarding the indications or technique for ALL reconstruction. The majority of surgeons do not change their postoperative protocol if an ALL reconstruction is performed.

Instability After Accelerated Rehabilitation Program Following Medial Patellofemoral Ligament Reconstruction

Abstract ID: Paper 026

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INTRODUCTION: Patellofemoral instability with recurrent patellar dislocations is a debilitating condition that frequently affects a young, active patient population. Isolated medial patellofemoral ligament (MPFL) reconstruction has emerged as an effective treatment of recurrent patellar dislocations that occur in the absence significant patellofemoral malalignment or osseous abnormalities. Rehabilitation following MPFL reconstruction has typically involved bracing, extensive limited weight-bearing and slow advancement in range of motion. We hypothesize that an accelerated rehabilitation program following MPFL reconstruction will yield low rates of recurrent dislocation and subsequent treatment failure.

METHODS: Chart review identified MPFL reconstructions without concurrent bony procedures (such as tibial tubercle osteotomy) performed between 2008 and 2015 by a single sports medicine fellowship-trained orthopedic surgeon at our center. Each patient underwent an accelerated rehabilitation program with immediate weight-bearing, early range of motion, no bracing, and initial postoperative strengthening exercises focused on hip abductors, external rotators, and extensors. Patient demographics (age and sex) and surgical data were identified by chart review. Chart review and patient interviews were undertaken to identify recurrent patellar dislocations and surgical revisions.

RESULTS: Data was collected in 54 patients undergoing the accelerated rehabilitation program with complete baseline data and minimum 1 year follow-up following isolated MPFL reconstruction. Recurrent dislocation occurred in 1 patient following the accelerated MPFL postoperative rehabilitation protocol (1.9 %). This was treated non-operatively, there were no surgical revision reconstructions performed.

CONCLUSION: An accelerated rehabilitation program following isolated MPFL reconstruction yields a low risk of repeat dislocation (<2%), and is comparable to the current rate in the literature.

A Biomechanical Comparison of Suture Anchor vs. Interference Screw Reconstruction for Medial Patellofemoral Ligament Reconstruction

Abstract ID: Paper 027

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BACKGROUND: There are numerous techniques for MPLF reconstruction; however, one single technique has not been proven to be superior to another. Suture anchor reconstructions has been shown to provide stable fixation while decreasing the risk of patellar fracture.

HYPOTHESIS/PURPOSE: To evaluate the stiffness of the native MPFL at sub-failure loads and compare those values to two MPFL reconstruction techniques: interference screw reconstruction and suture anchor reconstruction and to determine the initial stiffness and failure loads of the two reconstructions in comparison to previously established results for the native MPFL. We hypothesize that there would be no significant difference in the ultimate failure load between the suture anchor and interference screw reconstructions and that the stiffness of both reconstructions would not differ significantly from that of the native MPFL.

METHODS: Eight pairs of fresh frozen cadaveric knees were randomized into two groups undergoing MPFL reconstruction using either a suture anchor technique (n=8) or an interference screw technique (n=8). Cyclic loading was performed at 0, 30, 60, and 90 degrees of flexion for the native knee, transected medial structures, and reconstructed MPFL. Upon completion of the cyclic testing, the reconstructed MPFL specimens were tested until failure in 0 degrees of flexion. T test, One-Way ANOVA, and repeated measures of ANOVA were used for statistical analysis with $p < 0.05$ considered as a significant level.

RESULTS: The average stiffness for the suture anchor and interference screw reconstructions was 12.02 ± 3.96 N/mm and 14.21 ± 4.20 N/mm, respectively (t test, $p = 0.27$), while average load to failure was 256.57 ± 54.1 N and 237.81 ± 23.82 N, respectively (t test, $p = 0.38$). No significant difference in restraining force was observed at 0 and 30 degrees of flexion for the suture anchor technique vs. native MPFL (One Way ANOVA, $p > 0.05$). There was no significant difference in stiffness between the suture anchor and interference screw techniques at 0, 30, and 60 degrees of flexion. Significant increase in restraining force was observed at 60 and 90 degrees of flexion for the two techniques when compared to the native MPFL (One Way ANOVA, $p < 0.05$).

CONCLUSIONS: The suture anchor and interference screw reconstruction techniques produce comparable stiffness for sub-failure testing at 0 and 30 degrees of flexion angles. For testing to failure, the initial stiffness for both reconstruction techniques have been shown to be concordant with previously published values for the native MPFL. Both reconstruction techniques provide greater ultimate failure loads than those reported for the native MPFL in previous studies.

High Rate of Recurrent Meniscal Tear and Progression to Lateral Compartment Osteoarthritis in Patients with Lateral Discoid Meniscus: A Long-Term Population-Based Study

Abstract ID: Paper 028

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BACKGROUND: Little is understood about the natural history and long-term outcomes of discoid meniscal lesions in the young patient population. The goals of this study were to describe the rate and factors associated with tear/recurrent meniscal tears after surgical treatment, as well as progression to lateral compartment osteoarthritis (OA) in patients with lateral discoid meniscus.

METHODS: We performed a chart review of 79 patients presenting with symptomatic lateral discoid meniscus between 1998 and 2015. Those with a minimum of two years clinical follow-up were included. Kaplan-Meier survivorship analysis was used to assess cumulative incidence of lateral meniscal tear/re-tear after index procedure, all-cause re-operation, and radiographic progression to lateral compartment OA. A cox regression model was used to assess risk factors associated with meniscal tear/re-tear and progression to lateral compartment OA after index procedure.

RESULTS: Of the 79 patients identified, 70 patients with a mean age of 27 years (Range: 2.0 – 66.0) met inclusion criteria. Sixty patients converted to surgical management at a mean of 0.8 years (Range: 0.0 – 7.1 years). Of these, 25 (41.7%) patients underwent partial lateral meniscectomy, 24 (40%) underwent discoid meniscus saucerization, and 11 (18.3%) underwent meniscal repair. Tear-free survival following surgery was 92.8% at 2 years, 69.0% at 5 years, and 40.2% at 10 years. Overall progression to lateral compartment OA was 10% at 2 years, 22.9% at 5 years, and 49.3% at 10 years. Of those patients who developed early lateral compartment OA, 59% (13/22) had a Kellgren-Lawrence score 2 or greater at last radiographic follow-up. Young age was associated with increased incidence of postoperative tear (HR: 0.96, CI: 0.93 – 0.99, $p = 0.01$). Operative intervention performed was found to have no significant effect on outcome, with meniscectomy and saucerization performing similarly to meniscal repair when evaluating hazard of postoperative re-tear, repeat surgery, and progression to lateral compartment osteoarthritis (all p -values ≥ 0.44). For every additional year in age at diagnosis, the risk for lateral compartment OA on final radiographs increased by 3% ($p = 0.012$).

CONCLUSION: Patients with a discoid lateral meniscus had a high rate of recurrent meniscal tear at long-term follow-up (60% at 10 years) that was associated with young age. Approximately 50% of patients developed early lateral compartment arthritis at 10 years from initial presentation. The risk of progression to OA increased with older age at diagnosis.

Level of Evidence: Retrospective case series, Level IV

MAOA BREAKOUT SESSION #3
TRAUMA
April 19, 2018

Teaching Basic Fracture Surgery Skills with the Basics of Open Reduction Internal Fixation Module: An Effective Low-Cost Simulation

Abstract ID: Paper 030

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INTRODUCTION: Skills training via laboratory-based surgical skill modules has been incorporated into post-graduate year (PGY) 1 training based upon mandates by the American Board of Orthopaedic Surgery (ABOS). The Basics of Open Reduction and Internal Fixation (ORIF) module includes syndesmotomic fixation in a cadaver model and less expensive simulations that provide training for basic fixation skills. The purpose of this study is to validate this module. We hypothesized that a didactic session and practice using a low fidelity polyvinylchloride (PVC) pipe simulation would improve PGY1 residents on cadaveric syndesmotomic fixation to a level comparable to senior residents.

METHODS: Eighteen PGY1 and six PGY5 residents were enrolled in this prospective cohort study. All PGY1 residents took part in a 6-hour Basics of ORIF module including faculty lecture, demonstration, and dedicated practice using PVC pipe and foam insulation as well as cadaveric specimens. Participants performed two medical knowledge tests (Instrument test and Lag Screw Technique test), in addition to a Cadaveric Syndesmotomic Screw Fixation test before (pretest), during (mid-test), immediately after (post-test) and one month after the module (Retention Test). A subgroup of 6 PGY1 residents that did not perform the pretest and all PGY5 residents (no training) served as control groups for this study. Face validity was assessed by participants and four traumatologists.

RESULTS: PGY1 scores on instrument knowledge and lag screw knowledge tests improved significantly ($p < 0.0001$) from pretest to post-test (4.6 to 11.6 out of 15 and 7.8 to 23.3 out of 30, respectively) and were maintained at one month. PGY1s also demonstrated significant improvement ($p < 0.0001$) on the Cadaveric Screw Fixation tests from a pretest Objective Structured Assessment for Technical Skills (OSATS) score of 18 to a post-test score of 29.3 out of 35, which was maintained at one-month and was not significantly different from the PGY5 average of 27.4 ($p = 0.42$). OSATS and knowledge scores were not significantly different between the PGY1 groups that did or did not complete the pretest. The PVC module received high validity ratings from the PGY1 class as well as four traumatologists. Total cost of materials for the course was \$50 for the PVC in addition to a cadaveric specimen cost of \$5,000.

DISCUSSION AND CONCLUSION: PGY1 residents significantly improved their knowledge and ability to perform syndesmotic screw fixation in cadaveric specimens to a proficient level in a short time using low cost, low fidelity PVC simulation.

Risk Factors for Prolonged Opioid Use After Orthopedic Trauma: Inner-City Hospital vs. Community Hospital

Abstract ID: Paper 031

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Use of prescription opiates has exponentially increased. The aim of this study was to identify risk factors associated with prolonged opioid use (>12 weeks) after isolated orthopedic trauma, comparing two different settings in the same city: large community based hospital vs. inner-city hospital.

Retrospective review was performed of orthopedic trauma patients > 18 years requiring operative intervention for isolated long bone fractures at 2 Level I trauma centers between 2011-2015. Patients were identified using CPT codes for femoral, tibial, humeral, forearm fracture fixation. Our exclusion criteria was <12 weeks follow-up, polytrauma (Injury Severity Score [ISS] >15), >1 operative procedure, periarticular fractures.

Demographic information, fracture type, mechanism of injury (MOI), index procedure, psychiatric history, employment status at time of injury, drug screen (opioid results excluded), blood alcohol, and smoking status at presentation, insurance type/status, preinjury opioid use, and duration of opioid use postoperatively was collected. The primary outcome was duration of postoperative opioid use classified as <6 weeks, 6-12 weeks, or >12 weeks. Categorical variables were analyzed using chi-square; Student t-test used for continuous variables. Risk factors were compared between the two hospitals.

There were 196 patients included (115 inner-city and 81 community hospital), mean age was 38.4±15 years with 68% males, mean ISS was 7±3. 51% of patients had low energy and 49% had high energy MOI.

With the results stratified by duration of opioid use: MOI (P=0.023), smoking (P=0.001), drug screen (P=<0.001), and insurance type (P=0.005) were significantly different between those who did vs. didn't stop using opioids by 6 weeks. Employment status (P=0.046), smoking (P=0.001), drug screen (P<0.001), insurance type (P=0.025), and preinjury opioid use (P=0.024) were significantly different between those who did vs. didn't stop using opioids beyond 12 weeks. There were no significant difference between gender, age, and fracture type in terms of prolonged opioid use.

In both community and inner-city hospitals, a positive drug screen and current smokers were associated with increased risk of prolonged opioid use (P<0.05).

Risk factors for prolonged opioid use were insurance type, employment status, and preinjury opioid use. Patients presenting with positive drug screen or current smokers were at an increased risk for prolonged opioid use, regardless of hospital setting. These findings can provide information on the psychological link between opioid dependence and risk-taking behaviors. Further studies are needed to determine the best treatment options for managing patients at high risk of developing opioid dependence after trauma.

Orthopedic Trauma Cost Stewardship; What Can I Do?

Abstract ID: Paper 032

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PURPOSE: With the affordable care act and anticipation of bundled payments affecting health care delivery, health systems and surgeons alike have been tasked with cost containment. The purpose of this study was to highlight novel approaches surgeons can take in practice to provide system cost savings that exemplify good stewardship of resources.

METHODS: Six fellowship-trained orthopedic trauma surgeons at Level 1 trauma centers participated in practicing six reproducible, novel approaches for system savings, ranging from standardizing implants and constructs to limiting unnecessary industry provided materials. Orthopedic trauma cost stewardship was realized with these easily employed surgeon controlled practices: (1) When fracture patterns of the ankle allow, standardizing an external fixator construct (utilizing less clamps, bars, etc.), (2) not obtaining standard radiographs of ankle and wrist fracture in the recovery unit, (3) hand mixing heat stabile antibiotic powder (i.e., Vancomycin/Tobramycin) into polymethyl methacrylate (PMMA) rather than using industry provided antibiotic laden PMMA, (4) utilizing a bolt/rod cutter to shorten locking screws if a miscalculated length resulted in the desire to replace a shorter screw, (5) avoiding use of an industry provided canal centralizer on cemented hip hemiarthroplasties, and (6) avoiding use of a non-industry provided guide pin for starting standard intramedullary nail constructs. Potential cost savings were then calculated based on our system pricing.

RESULTS: Total potential annual cost savings was estimated at \$308,039 with these simple and reproducible approaches. The most widely varied cost and highest potential for containment was seen in external fixator constructs. Irrespective of vendor, pin clamps and rod to rod connectors can significantly increase the total construct cost and thus wide variation was seen with several standard delta frame ankle spanning fixator constructs. Standardizing frame constructs for applicable ankle fractures could yield as much as \$133,569 in annual savings. Similarly, not obtaining radiographs for routine wrist and ankle fractures in the recovery room where quality and position is often poor had the ability to significantly lower costs by \$94,962.

CONCLUSION: At a busy Level 1 trauma center, a cost-conscience unified stewardship approach among our surgical team led to a total estimated cost savings of \$308,039. Ultimately, cost savings at other institutions will vary by implant/service pricing. However, these simple and reproducible methods can reduce costs in any system and are directly influenced by the stewardship of practicing orthopedic surgeons.

Long-Term Outcomes of Femoral Head Fractures: Minimum Follow-Up of Five Years

Abstract ID: Paper 33

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INTRODUCTION: Femoral head fractures are uncommon injuries often associated with poor results. Long-term outcomes are sparse in the literature and there is a paucity of information available to identify treatment factors that affect long-term functional outcomes. We present the longest follow-up of femoral head fractures reported in the literature and evaluated the results and functional outcomes at a minimum follow-up of five years.

METHODS: This is a retrospective review of all patients presenting to a single Level 1 trauma center between 1994 and 2015 with a femoral head fracture. Patients with less than five years of follow-up were excluded. Complications and clinical course were recorded. The Oxford Hip Score (OHS) was used to assess patient-reported functional outcome.

RESULTS: A total of 127 femoral head fractures were reviewed. Including only those patients with a minimum of 5-year follow-up left 35 femoral head fractures in 34 patients. The average follow-up was 10 years (range 5-18.2 years). The majority of patients (60%) had Pipkin 4 femoral head fractures (3 Pipkin I fractures, 8 Pipkin II fractures, and 3 Pipkin III fractures). At least 74% were associated with a hip dislocation. 11 femoral head fractures were treated nonoperatively (31%), 3 underwent excision (9%), 12 were treated with ORIF (34%), and 9 underwent arthroplasty (26%). 63% had a complication in the course of treatment (0 infections, 0 iatrogenic nerve palsies, 4 developed osteonecrosis, 10 with heterotopic ossification, and 14 developed posttraumatic arthritis). 7 patients underwent a secondary total hip arthroplasty with an average time to arthroplasty of 2.9 years. Oxford Hip Scores were available for 31 patients. The average Oxford Hip Score for all patients was 39.5 out of 48, which indicates good joint function. The average Oxford Hip Score for those who underwent primary arthroplasty (n=9) for treatment of their fracture was 43.2 compared to 39.7 in those treated without arthroplasty (n=13). Patients who went on to have a secondary total hip (n=7) (Oxford score of 34.6) did not score as well as those who were treated primarily with arthroplasty (Oxford score of 43.2). This difference was statistically significant ($p = 0.0312$).

CONCLUSION: Femoral head fractures have a high rate of post-traumatic arthritis. Patients who are treated initially with arthroplasty tend to have improved functional outcomes compared to those who undergo a secondary total hip replacement. Overall, however, most patients have good functional outcomes regardless of being treated with arthroplasty or other means.

Distal and Diaphyseal Femur Fracture Complications: A Systematic Review and Meta-Analysis

Abstract ID: Paper 034

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INTRODUCTION: Fracture nonunion greatly prolongs the burden of painful disability and financial cost for the patient. A nuanced understanding of the likelihood of nonunion and other causes of revision surgery after internal fixation is important to patient education and limiting the likelihood of complications. The objective of this study was to characterize the healing, nonunion, and total reoperation rates in distal and diaphyseal femur fractures in relation to the method of internal fixation used.

METHODS: We performed a systematic review and meta-analysis of all published records from PubMed, Embase, and the Cochrane Review system. We included studies that had a sample size of greater than 20 consecutive adult patients with acute, non-pathologic diaphyseal or distal femur fractures treated with primary internal fixation. Excluded were studies on abnormal patient populations, patient types or fixation techniques.

RESULTS: We included 38 studies with 2,829 diaphyseal femur fractures and 11 studies with 505 distal femur fractures. Over 93% of diaphyseal fractures and 87% of distal fractures healed without need for revision ($p < 0.00001$). The total reoperation rate was 12.9% in distal fractures and 6.6% in diaphyseal fractures ($p < 0.00001$), largely due to higher rates of mechanical failure ($p < 0.00001$) and deep infection ($p = 0.0001$) in distal fractures. Nonunion occurred in 4.8% of distal fractures and 3.1% of diaphyseal fractures.

Among distal fractures, there was no difference in healing, total reoperation, or nonunion rates between fixation with a nail or plate. There was also no difference in healing or complications between LISS plating and other contemporary alternatives.

Among diaphyseal fractures, antegrade and retrograde fractures had similar rates of healing and nonunion. Unreamed fractures had a higher rate of nonunion than reamed fractures ($p = 0.002$); however, there were too few studies for comparison.

CONCLUSION: Nonunion is the most common complication among distal and diaphyseal fractures, regardless of method of fixation. Further study is necessary to optimize fracture healing and patient outcomes.

Complication Rates for Converting Cephalomedullary Nail and Sliding Hip Screw Fixation of Intertrochanteric Hip Fractures to Total Hip Arthroplasty Are Similar

Abstract ID: Paper 35

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PURPOSE: There is a significant body of literature comparing fixation outcomes of intertrochanteric femur fractures with cephalomedullary nail (CMN) and sliding hip screw (SHS). The outcomes of converting failed fixation with CMN and SHS to THA have been limited to small single center case series. The purpose of this study was to determine the complication rate of converting failed fixation of intertrochanteric femur fractures to THA, compare the difference in complications when converting from a CMN and SHS, and compare both to primary THA in the same database.

METHODS: The PearlDiver Research Program was used to query the Humana Inc. administrative claims database from 2007 to the third quarter of 2015. The program was used to identify patients that underwent THA after operative treatment of a proximal femur fracture by either CMN or SHS using Current Procedural Terminology (CPT) codes and laterality modifiers. This group of patients was then queried to determine the frequency and nature of complications after the conversion procedure. Subgroup analysis was performed on the following complications: infection, dislocation, revision, periprosthetic fracture, and neurologic injury.

RESULTS: There were 452 patients that underwent conversion to THA from CMN and 153 from SHS that were identified in the database during the study period. The overall complication rate converting these devices to THA at 1 year after surgery was 28.9% (175/605). Complication rates were similar for conversion to THA from CMN (28.8%, 130/452) and SHS (29.4%, 45/175) ($p=0.44$). In the CMN conversion group, the rate of infection requiring return to the operating room was 5.1% (23/452) and dislocation occurred in 6.0% (27/452) of cases. This is significantly higher than the infection rate in primary THA of 1.5% (1087/72,315) (OR 3.51 [2.30-5.37]; $p<0.001$) and the dislocation rate in primary THA of 2.0% or (1475/72,315) (OR 3.05 [2.06-4.5]; $p<0.001$). The risk of dislocation was not significantly higher in the CMN group compared to SHS group (OR 1.56 [0.63-3.8]; $p=0.34$) nor was the risk of revision (OR 1.63 [0.55-4.88]; $p=0.38$) or periprosthetic fracture (OR 0.55 [0.20-1.55]; $p=0.26$).

CONCLUSIONS: Conversion THA after proximal femur fracture fixation is not a commonly performed procedure. The overall complication rate of converting to THA from CMN and SHS is high for both groups compared to primary THA, though not significantly different from each other. The rates of dislocation trended higher in the CMN group compared to SHS group, but the rate was not significantly different in this series.

Does Deep Drain Placement Affect Development of Heterotopic Ossification After Kocher-Langenbeck Approach with Gluteus Minimus Debridement for Treatment of Acetabular Fractures?

Abstract ID: Paper 036

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INTRODUCTION: Heterotopic ossification (HO) is a common complication after open reduction and internal fixation of acetabular fractures. Intraoperative debridement of the gluteus minimus muscle caudal to the superior gluteal neurovascular bundle has been suggested as a prophylactic measure against HO, but leaves a potential space for hematoma collection. Our null hypothesis is that placement of a deep drain after Kocher-Langenbeck (K-L) approach for open reduction and internal fixation of acetabular fracture with gluteus minimus debridement will not alter the rate of formation of clinically important heterotopic ossification.

METHODS: A single surgeon, consecutive cohort of patients with acetabular fractures treated with K-L approach were retrospectively reviewed for development of HO. The first 38 patients (Group I) did not have a closed suction drain placed deep to the fascia lata along the posterior column. The subsequent 21 patients (Group II) had a deep drain placed. Medical records and follow-up radiographs were followed at least 10 weeks postoperatively to monitor for development of HO, which was classified according to the modified Brooker system. Clinically important HO was defined as Brooker grades III and IV.

RESULTS: No statistically significant differences were found between the groups with regards to demographic data, fracture pattern, injury scores, and use of combined approaches. Without deep drain placement, the relative risk (RR) of any HO formation was 1.30 ($p=0.41$) and of developing clinically relevant HO was 1.93 ($p=0.38$). Relative risk of needing HO resection was 5.08 ($p=0.26$) for Group I. There were no infections in either group, and there was no increased risk for allogeneic transfusion in Group II. Post-hoc power analysis suggests that the study is underpowered and would need 39 patients in each group to achieve a power of 0.8 with significance set at $p=0.05$.

CONCLUSION: Deep drain placement after K-L approach with gluteus minimus debridement for acetabular fracture did not significantly decrease formation of clinically important HO, although our study appears to be underpowered and subject to Type II error.

Intraoperative Biomechanical Guidance Improves Articular Fracture Reduction

Abstract ID: Paper 037

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INTRODUCTION: Anatomic reduction of intra-articular fractures (IAFs) is critical for minimizing joint contact stress to reduce risk of post-traumatic osteoarthritis (PTOA). It has been shown that 2D fluoroscopic images are insufficient to reliably detect articular step-off > 2 mm and provide no information about patterns of joint contact stress. We have developed a biomechanical guidance image analysis system (BGS) that produces and updates intraoperative three-dimensional (3D) images of current articular fragment positions and maps predicted joint contact stress using standard 2D imaging. We compared experimental fracture reductions performed with and without BGS.

METHODS: Intra-articular distal tibia fractures were created in 5 cadaver ankles leaving soft tissues intact. The extremity was potted in bone cement, and a baseline CT image was acquired. Each fractured ankle was surgically reduced and fixed using percutaneous methods. Surgery was performed twice on each ankle (10 surgeries), in one surgery the BGS information was shown to the surgeon, and in one only standard fluoroscopic imaging was used by the surgeon to guide reduction. The order in which surgeries were performed was randomized. A postoperative CT scan was obtained to provide gold-standard data to compare to the final BGS assessment.

RESULTS: All surgical reductions were satisfactorily completed. Mean and maximum contact stresses were lower using the BGS in 4 of 5 cases tested. The average reduction was 0.71 and 1.51 MPa for mean and maximum contact stress, respectively. Contact area engagement histograms show that unguided cases had more areas at higher levels of contact stress than did the guidance cases. The system was used on average 4.8 ± 1.3 times per procedure. When compared to gold standard postoperative CT, alignment error in 2D-3D registration is 0.45 ± 0.57 mm in translation and $2.0 \pm 2.5^\circ$ in rotation. Contact stress distributions and fracture fragment orientations produced by guidance visually compared well to gold standard results. The difference in mean and maximum contact stress for intraoperative results vs. gold standard are 0.45 (7%) and 1.0 (4%) MPa, respectively.

CONCLUSION: A biomechanical guidance system was used to aid in the reduction of 5 fractured cadaver ankles. The system provides 3D imaging from standard 2D fluoroscopy and assesses the contact stress of various reductions real-time intraoperatively. Metrics of contact stress and contact area were improved in four of the five cases tested when the guidance was used compared to standard intraoperative 2D imaging. Future work will involve improving the core algorithms of the system, additional cadaveric experimentation, and eventual translation to the operating room.

Radiographic Healing of Far Cortical Locking Constructs in Distal Femur Fractures: A Comparative Study with Standard Locking Plates

Abstract ID: Paper 038

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INTRODUCTION: Distal femur fractures are commonly treated with locking plate fixation. These fractures are often comminuted and depend on some degree of interfragmentary motion to stimulate union. Far cortical locking (FCL) screw constructs are designed to permit increased controlled interfragmentary motion which has been shown in animal models to increase callus formation to a greater extent than standard locking plate (LP). Despite the use screws, actual clinical and radiographic data on the effectiveness has been limited. The purpose of this study is to investigate radiographic callus formation as a primary outcome of FCL compared with LP constructs, using the modified RUST score. Our hypothesis is that FCL constructs have increased callus formation as compared to standard LP constructs.

METHODS: A cohort of 146 distal femur fractures were identified retrospectively from 2011-2016. After excluding with AO/OTA Type B fractures, non-union cases, and less than 16 years old, 96 patients were included for analysis. AP and lateral knee of femur radiographs were reviewed using the Modified RUST score to evaluate callus formation of each cortex of the distal femur at 6, 12, 24 weeks and final follow-up when available. Radiographs for patients with plate fixation were blinded to the type of screws. There were 52 patients in the FCL group and 44 in the LP group.

RESULTS: There were no significant differences between FCL, LP constructs in terms of demographic data, or complications. The statistically significant differences in modified RUST scores were noted between groups at 6 weeks (p-value=0.02) and 12 weeks (p-value=0.04). These differences were no longer significant at 24 weeks or final follow-up. No significant differences were noted between groups for fixation failures, or nonunion rates.

CONCLUSION: To our knowledge, this is the first comparative study between FCL and LP constructs. In this study, the FCL group was noted to have significantly higher modified RUST scores at the 6 and 12 week time period. Further prospective study designs should be directed at helping to clarify the role of interfragmentary motion on callus formation in distal femur fractures.

Osteoporotic Fractures of the Distal Radius Compared to Osteoporotic Fractures of the Spine: A Review of Patient Risk Factors and Treatment Disparities

Abstract ID: Paper 039

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BACKGROUND: Low energy distal radius and vertebral compression fractures (VCF) are common injuries in the osteoporotic patient. In this study, the Own the Bone (OTB) database was examined to compare fracture-specific risk factors between patients with distal radius fractures against patients with osteoporotic fractures of the spine. Comparison data was analyzed with respect to pharmacologic treatment recommendations and initiation rates between these cohorts.

METHODS: This study used the American Orthopaedic Association's OTB program registry which contains data on 35,039 unique cases of insufficiency fracture. Patients presenting with a distal radius fracture and a VCF were excluded. There were 2,166 distal radius fractures and 3,838 VCF. Overall, 1,751 patients with distal radius (81%) and 2,850 patients with VCF (74%) were post-menopausal, Caucasian, and female (the osteoporotic terrible triad). Two hundred and eighty-seven (13%) of distal radius patients had a previous distal radius fracture while 1,204 VCF patients (32%) had a previous VCF. Odds ratios were calculated for 25 independent variables.

RESULTS: Postmenopausal, white, female patients were more likely (OR 1.46, $p < 0.001$) to suffer a distal radius fracture than a VCF. A patient with a previous distal radius fracture had a 2.2 times increased risk of a subsequent distal radius fracture (OR 2.18, $p < 0.001$). However, patients presenting with a distal radius fracture were significantly less likely to have had a history of a previous spine fracture (OR 0.08, $p < 0.001$). Overall, patients with distal radius fractures were significantly less likely to have treatment for osteoporosis recommended and initiated (OR 0.53, $p < 0.001$; OR 0.50, $p < 0.001$, respectively).

CONCLUSIONS: Distal radius fractures and VCF remain some of the most common insufficiency fractures. While the OTB database contains similar numbers of distal radius and vertebral compression fractures, patients who present with a distal radius fracture are significantly less likely to have treatment for osteoporosis recommended or initiated. Understanding the risk factors unique to specific insufficiency fracture types as well as the treatment disparities for these diverse fractures is critical to identifying patients at risk for these fractures and improving the care of these patients once such a fracture has occurred.

Treatment Outcomes and Revision Surgery Following Hip Hemiarthroplasty Dislocation

Abstract ID: Paper 040

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PURPOSE: Dislocation following hip hemiarthroplasty is less common than for total hip arthroplasty. Risk factors identified for dislocation include increased time from fracture to initial surgery and small center-edge angle. Treatment options include closed reduction, revision hemiarthroplasty, conversion to total hip arthroplasty, and resection arthroplasty. While prior studies have identified risk factors for dislocation, the proportion of patients who undergo the different treatment options and their outcomes is not known. Our project aims to evaluate the details of treatment following hemiarthroplasty dislocation and to understand the typical postoperative course of a patient who undergoes revision surgery.

METHODS: Patients who underwent a hip hemiarthroplasty between January 2005 and December 2016 for femoral neck fracture (OTA 31-B2, 31-B3) and subsequently dislocated were included in the study. Demographic details and co-morbidities at time of index surgery were collected. Surgical details such as operating time, estimated blood loss (EBL), transfusion, intensive care unit (ICU) stay, approach, postoperative complications, and length of stay (LOS) were collected. Time to dislocation and number of dislocations were recorded. Dislocation treatments, postoperative course, and dislocations following revision surgery were also recorded.

RESULTS: 1,141 patients underwent a hip hemiarthroplasty during this time. 39 patients experienced a dislocation. 25 patients dislocated just once, while 6 patients dislocated 3 or greater times. Median time to dislocation was 20 days, with 27 who dislocated within 30 days and 2 who dislocated greater than 2 years postoperative. The only variable correlated with quicker time to dislocation was dementia. Patients with dementia dislocated on average at postoperative day 16 compared to postoperative day 31 in patients without dementia. No patients who underwent operative treatment of their dislocation experienced a subsequent dislocation. Number of dislocations was not associated with age, gender, dementia, unipolar vs. bipolar index prosthesis, or index component position judged as appropriate or varus.

CONCLUSION: Understanding the course of patients who dislocate following a hip hemiarthroplasty can help guide patient education and treatment. Revision operating room time and estimated blood loss are higher in revision surgery than index surgery, while length of stay was not. About half of patients who underwent a revision surgery required ICU.

MAOA BREAKOUT SESSION #4
HIP AND KNEE ARTHROPLASTY INFECTION
April 19, 2018

Survivorship Analysis of an Articulating Antibiotic Spacer for Total Knee Arthroplasty Periprosthetic Joint Infections

Abstract ID: Paper 041

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INTRODUCTION: Periprosthetic joint infections (PJI) of a total knee arthroplasty (TKA) occur in approximately 2% of primary TKAs but is a devastating complication resulting in increased cost and morbidity. The current gold-standard in the United States is a two-stage revision. We utilize a modified two-stage revision technique with an articulated spacer with the intent of providing higher function and longer term survival. The technique uses a new femoral component, an all-polyethylene tibia, and a new patellar component fixed with antibiotic cement. Revision to definitive components is delayed until the spacer mechanically fails, unless further surgery is required to eradicate the infection. The purpose of our study is to investigate the survivorship of this technique as defined by mechanical failure or failure to eradicate infection.

METHODS: A retrospective review of patients undergoing revision TKA performed by a single surgeon between January 2010 and March 2017 were reviewed. Patients who had an infected TKA that underwent placement of an articulating antibiotic spacer were identified. Inclusion criteria were: age 18 or older undergoing surgery for an infected TKA using the studied technique with minimum 1-year follow-up. Age, gender, time to failure, reason for failure, complications, and survivorship of spacer were recorded.

RESULTS: 38 TKAs in 37 patients met our criteria and included 24 females (65%) and 13 males (35%) with a mean age of 64.3 ± 9.3 years. 13 spacers (34%) required subsequent surgery (failed) at a mean 9.7 (range 3.1-19.1) months. 6 spacers (16%) failed due to failure of eradication of infection and 7 (18%) failed due to mechanical failure. Two patients required revision to a rigid spacer; one due to dislocation of the spacer, one for persistent infection. One patient had persistent infection with loss of soft tissue leading to knee arthrodesis. The remaining 25 spacers had an average survivorship without failure of 32.0 (range 13.0-66.6) months at last follow-up. Two patients required subsequent surgery for wound healing complications without revision of the spacer; otherwise, there were no complications. Kaplan-Meier survival analysis using revision for any reason as an endpoint demonstrated 76% survivorship at one year and 63% survivorship at two years. Kaplan-Meier survival analysis evaluating infection-free survival demonstrated 92% survivorship at one year and 81% survivorship at two years.

CONCLUSION: Our modified articulating spacer technique shows excellent survivorship and

function with comparable success rates for eradication of infection when utilized in the treatment of prosthetic TKA infections.

Cell Count and Differential of Aspirated Fluid in Immunosuppressed Patients in the Diagnosis of Total Knee Arthroplasty Prosthetic Joint Infections: A Case Series

Abstract ID: Paper 042

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INTRODUCTION: Prosthetic joint infection (PJI) is a deleterious complication of total knee arthroplasty (TKA). A mainstay of diagnosing PJI is the synovial aspirate. While the Musculoskeletal Infection Society (MSIS) has provided cutoff values for synovial leukocyte count and neutrophil percentage, it is unknown if these values are valid in patients with compromised immune systems. We sought to assess whether the accepted cutoff values for synovial leukocyte count and neutrophil percentage are valid in targeted immunosuppressed individuals.

METHODS: We retrospectively analyzed synovial aspirates from 17 patients who had previously undergone a TKA and had one of a number of targeted diagnoses indicative of immunosuppression; 5 were found to be infected, 12 were not. Sensitivity, specificity, positive predictive value, and negative predictive value were calculated using the MSIS cutoff values as well as various combinations with serum erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP).

RESULTS: The median synovial fluid leukocyte count (26,000 compared with 314 cells/ 10^{-3}cm^3 ; $p < 0.001$) and neutrophil percentage (84% compared to 26%; $p = 0.002$) were significantly higher in patients with PJI. Applying the defined cutoff value for leukocyte count (>1100 cells/ 10^{-3}cm^3) and neutrophil percentage ($>64\%$) to our cohort, we found identical sensitivities and specificities of 100% (95% confidence interval, 56.6% to 100%) and 83.3% (95% confidence interval, 55.2% to 95.3), respectively.

CONCLUSION: The present study suggests that a synovial fluid cell count of >1100 cells/ 10^{-3}cm^3 and a neutrophil percentage $>64\%$ are adequate cutoff values to differentiate between TKA with and without infection in targeted immunosuppressed individuals.

KEYWORDS: Prosthetic joint infection; total knee arthroplasty; aspirate

Two-Stage Total Knee Arthroplasty for Periprosthetic Joint Infection in the Era of Articulating Spacers: Indications and Outcomes

Abstract ID: Paper 043

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INTRODUCTION: Two-stage exchange total knee arthroplasty (TKA) remains the gold standard for chronic periprosthetic joint infection (PJI). While articulating spacers are becoming increasingly prevalent, there is little evidence on specific patient indications and outcomes. The goal of this study was to analyze articulating and static TKA spacers with emphasis on: (1) survivorship free of infection, (2) clinical outcomes, and (3) complications.

METHODS: 115 TKAs (110 patients) with PJI treated with two-stage exchange from 2010–2014 at a single institution were retrospectively reviewed. Mean follow-up was 3.5 years (range, 2–7 years) and 54% were female. Mean age was 68 years and mean BMI was 33 kg/m². PJIs were classified per the Musculoskeletal Infection Society (MSIS) and host-extremity risk factors were classified per McPherson. There were 36 articulating and 79 static spacers utilized. Indications for static spacers included patients with: (1) extensor mechanism disruption, (2) bone loss precluding articulating spacer use, (3) the need for soft-tissue coverage, and (4) high risk of wound complications.

RESULTS: Survivorship free of any infection was 84% and 78% at 2 and 5 years, respectively. Host grade C (HR=7.9, p=0.002) and extremity grade of 3 (HR=3.5, p=0.005) were significant risk factors for poorer infection-free survival. Mean Knee Society Scores (KSS) improved from 65 preoperatively to 90 postoperatively (p<0.001); there was no significant difference between articulating and static spacers. There were no significant differences in complications during the treatment period (p >0.1) or after reimplantation (p>0.1).

CONCLUSION: Both static and articulating spacers yield excellent survival free of infection and clinical outcomes with minimal complications in knee PJI. Poor host and extremity factors lead to poorer infection eradication. While articulating antibiotic spacers can maintain patient function during the treatment phase, there is still a role for static antibiotic spacers in more compromised hosts and extremities.

The Risk of Acute Infection Following Intra-Articular Corticosteroid Injection into a Pre-Existing Total Knee Arthroplasty

Abstract ID: Paper 044

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INTRODUCTION: No previous studies have investigated the risk of infection following intra-articular corticosteroid injection (IACI) into a pre-existing total knee arthroplasty (TKA). The aim of this study was to determine the risk of acute infection following IACI into a pre-existing TKA.

METHODS: A retrospective chart review identified all patients at a single institution between October 2009 and May 2015 that had an ipsilateral knee injection subsequent to a TKA. The risk of acute infection, as defined by development of an infection within three months of IACI, was determined via review of clinic notes, operative reports, laboratory records, and telephone interviews.

RESULTS: A total of 1,845 injections in 736 patients met the inclusion criteria. 101 (4.8%) patients were lost to follow-up. Three infections in three patients occurred within three months of IACI, yielding an infection rate of 0.16% per injection, or 1 infection in every 625 IACI following TKA.

DISCUSSION: This study is the first to investigate the risk of acute infection following injection of corticosteroid into a pre-existing TKA. Given the dire consequences of infection following TKA, the routine use of IACI into a pre-existing TKA should be avoided, and a thorough work-up should be performed in any patient with a painful TKA prior to consideration of IACI.

Prophylactic Antibiotic Use and Reinfection After Two-Stage Revision Total Knee Arthroplasty

Abstract ID: Paper 045

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INTRODUCTION: Reinfection following two-stage revision for infected total knee arthroplasty remains a significant problem. In this retrospective study, we examined if variable antibiotic durations post-second stage were associated with a difference in reinfection rate.

METHODS: We performed a retrospective cohort study of adult patients undergoing two-stage revision total knee arthroplasty at a tertiary medical center between 2010 and 2016. Patients were eligible for inclusion if they met the Musculoskeletal Infection Society criteria for prosthetic joint infection at the time of first stage and did not meet the criteria at the time of second stage. Logistic regression analysis, survival analysis, and multivariate regression analysis were performed, with the reinfection as the primary outcome of interest and duration of antibiotics as the main predictor of interest. Other predictors, including age, sex, smoking status, organism, Charlson Comorbidity Index score, BMI, ESR, and CRP, were evaluated for possible association with reinfection.

RESULTS: Between January 2010 and December 2016, 86 patients were eligible for inclusion. Participants had a mean age of 63 years (range 40-85) and BMI of 34 kg/m² (range 21.8-51.4). Mean follow-up time was 595 days. Onset of infection occurred at a mean of 153 days (range 6-1,002) following the second stage procedure. Forty-seven patients (54.7%) received < 7 days of antibiotics, seven (8.1%) received 7-13 days, eleven (12.8%) received 14-29 days, eight (9.3%) received 30-89 days, and thirteen (15.1%) received ≥ 90 days. Reinfection occurred in seventeen patients and could be classified as persistent in nine (53%), new in five (29%), and unknown in three (18%). At three-month follow-up, there was no significant association between antibiotic duration and reinfection ($p > 0.05$). At twelve-month follow-up, patients who had received ≥ 90 days of antibiotics had a significantly lower rate of reinfection than those who had not (0% versus 31%; relative risk, 0.75; 95% confidence interval, 0.63-0.89; $p = 0.05$). Female sex trended toward an independent risk factor for reinfection in the survival analysis (hazard ratio 2.66, $p = 0.06$). None of the other examined variables had a statistically significant association with reinfection in the survival or multivariate analyses.

CONCLUSION: Antibiotic duration greater than or equal to 90 days post-second stage revision total knee arthroplasty for infection may be associated with a significant reduction in reinfection rates.

Outcomes of Treatment of Periprosthetic Hip and Knee Infection Are Not as Successful as Previously Reported

Abstract ID: Paper 046

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INTRODUCTION: Two-stage revision is the preferred treatment for periprosthetic hip and knee infection because of reported high rates of success. Recent studies have questioned the success rate of periprosthetic infection treatment, because many patients do not ultimately undergo prosthesis reimplantation. The purpose of this study is to investigate the clinical course of periprosthetic hip and knee infection following resection arthroplasty and spacer insertion at a single institution.

METHODS: We identified 95 patients who underwent prosthetic resection and spacer placement for infection over a 17-year period. 15 cases were excluded based on pre-set exclusion criteria leaving 80 cases (56 knees, 24 hips). A retrospective chart review was performed to examine the clinical course of these patients.

RESULTS: Following spacer placement, 9 (11.25%) of the 80 joints underwent repeat debridement for persistent infection. 24 patients had a serious complication during their treatment course including five periprosthetic femur fractures, four venous thromboemboli, four disseminated infections, two spacer dislocations, two extensor mechanism disruptions, one achilles tendon contracture, and three perioperative deaths. 14 patients (17.5%) never underwent reimplantation. Of those, 10 (71.43%) were treated with spacer retention, two had resection arthroplasty, and one each had an amputation and an arthrodesis. Of the 59 patients with successful reimplantation, 42 (71.19%) remained infection free at most recent follow-up.

CONCLUSIONS: Treatment of periprosthetic infection does not result in the high rates of eradication reported with two-stage revision alone. A large number of patients undergoing the first stage of two-stage revision never undergo the subsequent reimplantation surgery, confirming previous studies. Of those who underwent reimplantation, fewer achieved infection eradication than previously reported, and many required additional spacer exchange or had a major complication. Reports of success for periprosthetic infection treatment should incorporate these considerations to give more accurate expectations of outcomes.

Does the Percent Change in ESR and CRP Predict Reinfection Risk in a Two-Stage Protocol for Treating Periprosthetic Joint Infection?

Abstract ID: Paper 048

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INTRODUCTION: Two-stage arthroplasty remains the gold standard for treating chronic periprosthetic joint infections (PJI). A delta threshold value of the sedimentation rate (ESR) and C-reactive protein (CRP) to determine the proper timing of reimplantation remains ill defined. Our study aimed to determine if the percent change of ESR and CRP values from pre-resection to pre-reimplantation (Δ ESR, Δ CRP) is a useful marker of infection eradication.

METHODS: We retrospectively reviewed 270 subjects treated with a two-stage revision arthroplasty between 2005-2014 from two separate institutional arthroplasty registries. ESR and CRP values were obtained prior to explantation and antibiotic spacer and after completion of 6 weeks of intravenous antibiotics, but prior to reimplantation. All subjects met the modified MSIS diagnostic criteria for PJI. Patient records were reviewed for infection recurrence for a minimum of 2 years. Culture results and patient demographics were analyzed with receiver operator curves (ROC) controlling for ASA class.

RESULTS: 18 subjects (6.7%) underwent a revision procedure for recurrent or persistent infection while 14 subjects (5.2%) were revised for non-infectious reasons. Causative PJI organisms included 61 coagulase-negative staphylococcus (22.6%), 29 MRSA (10.7%), 42 MSSA (15.5%), and 32 Streptococcus species (11.8%). Forty-one cases (15.1%) were culture-negative. The median Δ ESR was 45.7% for those subjects who remained infection free vs. 33.8% who became reinfected ($p=0.76$). The median Δ CRP was 82.1% for those subjects who remained infection free vs. 65.7% for those who experienced reinfection ($p=0.23$). Receiver operator characteristic area under the curves (AUC) demonstrated that the Δ ESR (0.49) and Δ CRP (0.59) percentages were poorly predictive of reinfection risk.

DISCUSSION: The Δ ESR and Δ CRP provides no additional diagnostic accuracy when determining infection eradication in two-stage revision arthroplasty based on AUC analysis. Further studies are necessary to define the optimal measure for determining eradication of infection prior to reimplantation to prevent PJI recurrence.

Postoperative Blood Glucose Levels Predict Infection After Total Joint Arthroplasty

Abstract ID: Paper 049

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BACKGROUND: Perioperative hyperglycemia has many etiologies, including medication, impaired glucose tolerance, uncontrolled diabetes mellitus, or stress, the latter of which is common in post-surgical patients. Our study investigated the influence of postoperative blood glucose levels on complications after elective total joint arthroplasty (TJA), including periprosthetic joint infection (PJI), and to determine a threshold for glycemic control that surgeons should strive for during a patient's hospital stay.

METHODS: A single-institution retrospective review was conducted on 24,857 primary TJAs performed from 2001-2015. Of these, 13,198 had a minimum of one-year follow-up (mean 5.9 years). Postoperative day 1 morning blood glucose levels were utilized and correlated with PJI, as defined by the International Consensus Meeting for PJI. Multivariable analysis was used to determine the influence of several important covariates on complication rates. An alpha level of 0.05 was used to determine statistical significance.

RESULTS: The rate of PJI significantly increased linearly from blood glucose levels of 115 mg/dL and higher. Multivariable analysis revealed that blood glucose levels were associated with PJI. The optimal blood glucose threshold to reduce the likelihood of PJI was 137 mg/dL. The PJI rate in the entire cohort was 1.59% (1.46% in non-diabetics vs. 2.39% in diabetics, $p=0.001$). There was no association between blood glucose level and PJI in diabetics, although there was a linear trend.

CONCLUSION: The relationship between postoperative blood glucose levels and PJI increased linearly, with an optimal cut off of 137 mg/dL. Immediate and strict postoperative glycemic control may be critical in reducing postoperative complications, as even mild hyperglycemia was significantly associated with PJI.

Diagnosing Periprosthetic Hip and Knee Joint Infection in Patients with Inflammatory Arthropathy Treated with Immunomodulating Agents

Abstract ID: 050

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INTRODUCTION: Inflammatory arthropathy is an independent risk factor for periprosthetic joint infection (PJI). Diagnosing PJI in this cohort is challenging given baseline elevation in inflammatory markers, and immunosuppression with DMARDs and novel biologic agents. The effect of immunomodulating agents on ESR and CRP has not been elucidated. The purpose of this study was to determine the effect of DMARDs and biologic agents on inflammatory markers in the setting of PJI.

METHODS: Between 2000 and 2016, 84 patients were identified with culture-positive PJIs (28 hips and 56 knees) being actively treated with a DMARD (53) or biologic agent (31). The mean age was 65 years and with 63% females. Preoperative ESR, CRP, and aspiration results including total nucleated cells, percent neutrophils (PMNs), and culture results were reviewed.

RESULTS: Mean ESR was 51 mm/hr (range, 3 – 148), with 71% above the upper normal limit of 29 mm/hr. Mean overall CRP was 76 mg/L (range, 2.6 – 400), with 86% above the upper normal limit of 8.0 mg/L. A mean of 55,101 nucleated cells (range, 52 – 384,813) and a mean of 83% PMNs were observed on aspiration. The mean ESR for patients on biologics was 44 mm/hr compared to 55 mm/hr for those on DMARDs ($p = 0.20$). The mean CRP for those on biologics was 64 mg/L compared to 84 mg/L for patients on DMARDs ($p = 0.08$). Tocilizumab ($n=3$) resulted in a lower mean ESR (14 mm/hr) and CRP (7 mg/L) compared to those on other biologics ($p = 0.04$ and 0.02 , respectively) and to those on DMARDs ($p = 0.02$ and 0.02 , respectively). However, aspiration results were consistent with PJI. In these 3 patients, all values were within normal limits except for 1 patient with a mildly elevated CRP of 12.5 mg/L.

DISCUSSION AND CONCLUSION: Diagnosing PJI in patients with inflammatory arthropathy on immunomodulating agents is challenging. Although inflammatory markers were generally elevated, there was a trend towards lower values in those being treated with novel biologic agents. This effect was most pronounced with tocilizumab, an IL-6 antagonist, that has been shown in the rheumatologic literature to normalize inflammatory markers. Even with normal screening laboratory tests, patients with a painful joint arthroplasty being treated with tocilizumab should have further infection work-up with an aspiration, which appears to be dependable.

Rethinking our Decision Making in Managing Chronic Periprosthetic Total Hip Infections: Using Predictive Analytics to Find the Optimal Strategy Between One-Stage and Two-Stage Total Hip Revision

Abstract ID: Paper 051

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BACKGROUND: Chronic periprosthetic infections (PJI) following total hip arthroplasty (THA) are managed with either a 2-stage or 1-stage revision. Although the 2-stage strategy has a higher rate of eradicating infection and is considered the gold standard for PJI management, there is significant morbidity and mortality associated with this approach. The 1-stage strategy is associated with lower mortality rates, fewer operations, and better quality of life. However, the 1-stage strategy is also affiliated with higher reinfection rates. Surgeons are faced with a difficult decision of which method to implement considering the uncertainty of infection eradication, the patient's postoperative quality of life, and the societal costs with each strategy. The purpose of this study is to use analytics to determine the optimal decision for the management of PJI following THA.

METHODS: An expected-value decision tree was constructed to estimate quality-adjusted life years (QALY) and costs with each strategy. A separate decision tree was constructed for methicillin-resistant staphylococcus aureus infections. Values for critical parameters such as mortality rate, reinfection rate, and need for additional surgeries were derived from the literature. The Markov model was used to estimate QALY over a 15-year period. Medical costs were derived from the Medicare database. Sensitivity analysis was performed to determine which parameters influenced the optimal strategy.

RESULTS: In both decision trees, the 1-stage strategy produced the most QALYs. The 1-stage strategy was also the most cost-effective solution. In the Monte Carlo simulation, 1-stage was the dominant strategy in over 70% of trials in both decision trees. Sensitivity analysis showed that both the mortality rate within the first year of surgery and the rate of reinfection were the most sensitive parameters influencing the optimal decision. Strategy tables showed how changing two parameters simultaneously changes the optimal decision.

CONCLUSION: Despite a higher infection eradication rate with a 2-stage strategy, the optimal decision that produces the highest quality of life is the 1-stage strategy. These results should be used in shared decision making with patients who suffer from PJI following THA.

Success of Two Stage Revision Arthroplasty in Patients Requiring an Interim Spacer Exchange

Abstract ID: Paper 052

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Abstract:

BACKGROUND: Two-stage revision arthroplasty is considered the standard of care for the treatment of periprosthetic joint infection (PJI). Some patients require an interim spacer exchange with debridement before the reimplantation surgery due to persistent infection. Although many studies have evaluated the success rates of two-stage revision arthroplasty, limited data is available on the success of two-stage revision in patients undergoing a spacer exchange. The purpose of the study was to compare the success of two-stage revision arthroplasty in patients receiving a spacer exchange with those who do not.

METHODS: From 2001-2014, 501 spacer implantations performed for hip or knee PJI were identified from the infection database at a large academic institution. Of these, 416 (83%) finally underwent a reimplantation. These revisions were screened to identify if these patients required one or more interim spacer exchanges before reimplantation. After excluding 70 patients lacking a minimum two years of follow-up, 347 revisions (hips=117, knees=230) were included for the analysis. An interim-spacer exchange was performed in 59 (17%) patients (exchange group). Successful two stage revision was defined as: (1) control of infection, as characterized by a healed wound without fistula, drainage, or limiting pain; (2) no subsequent surgical intervention for infection after reimplantation surgery; and (3) no occurrence of PJI-related mortality. Kaplan-Meier survival curves and multivariate Cox proportional hazards model were performed to compare the success rates between the exchange and non-exchange groups.

RESULTS: Mean time between initial spacer implantation and final reimplantation was longer in the exchange group (218 vs. 127 days, $p < 0.001$). At a mean follow-up of 4.3 ± 3.8 years, 91 failures (exchange=20, non-exchange=71) were observed. The 2-year and 5-year success rates were 77% and 66% in the exchange group, and 86% and 77% in non-exchange group. The spacer exchange group had a lower infection-free survival (unadjusted HR=1.76 [1.07-2.90], $p=0.027$; adjusted HR=1.69[1.02-2.81], $p=0.039$)

CONCLUSION: Patients requiring an interim spacer exchange have a prolonged treatment period and about one-third of such patients get re-infected within 5 years. Despite the additional attempt at clearing infection, patients who require an interim spacer exchange have a lower success rate after two-stage revision.

MAOA BREAKOUT SESSION #5
Tumor/Education/Practice Management
April 19, 2018

A Comparison of Outcomes of Treatment Paradigms for Sacral Chordoma: Does Preoperative Radiation Improve Prognosis?

Abstract ID: Paper 053

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BACKGROUND: The treatment for sacrococcygeal chordomas is en-bloc excision with negative margins; however, this often leads to significant morbidity. Following surgical resection, there remains a high rate of local recurrence. As such, some institutions combine preoperative radiotherapy with surgical excision in an attempt to reduce the risk of local recurrence. The purpose of this study was to compare cohorts from four tertiary sarcoma centers in North America to determine if preoperative radiotherapy can improve outcomes, with a focus on (1) overall survival, (2) recurrence free survival, and (3) postoperative complications.

METHODS: 239 patients who underwent surgical excision of a primary sacrococcygeal chordoma at our institutions from 1990-2015 were identified; including 84 females and 155 males, with a mean age and follow-up of 59 years and 6 years (range 1 to 25 years). All patients underwent resection with curative intent. Negative margins were obtained in 204 (85%) patients. Neoadjuvant radiotherapy was administered to 105 patients (44%), with a mean dose of 41 Gy. There was no difference in the mean age ($P=0.21$), proportion of males ($P=0.68$), mean tumor volume ($P=0.25$), proportion of high sacral resections ($P=0.24$), and proportion of positive margins ($P=0.10$) between patients who did or did not receive radiation.

RESULTS: The 10-year recurrence-free and overall survival was 59% and 60%. Patients with tumor size greater than 9 cm were at increased risk of mortality (HR 2.21, $P=0.001$) and disease recurrence (HR 1.94, $P=0.01$). Local recurrence occurred in 40 (17%) patients, with 10-year local recurrence-free survival of 74%. A positive surgical margin was associated with local tumor recurrence (HR 2.24, $P=0.03$), and local recurrence was associated with metastatic disease (HR 2.76, $P<0.001$).

Postoperative complications occurred in 54% of patients; most commonly wound breakdown ($n=76$) and sacral insufficiency fracture ($n=27$).

Preoperative radiotherapy did not reduce the risk of mortality (HR 1.23, $P=0.42$), local

recurrence (HR 0.69, $P=0.29$), or development of metastatic disease (HR 1.13, $P=0.70$); however, did increase the risk of postoperative wound complications (HR 2.85, $P<0.001$) and sacral fractures (HR 6.21, $P<0.001$).

CONCLUSION: The ability to achieve a negative margin and tumor size were the most important predictive factors for mortality and local recurrence in the surgical treatment of sacral chordoma. In this retrospective multi-center study, preoperative radiotherapy did not reduce the risk of mortality, local tumor recurrence, or metastasis. However, preoperative radiotherapy was associated with a significantly increased risk of wound complications and sacral fracture.

Non-Surgical Outcomes In Multiple Myeloma Peri-Acetabulum Lesions

Abstract ID: Paper 054

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BACKGROUND: Multiple myeloma is a malignancy of the hematologic system very commonly affecting the skeletal system, with the incidence of periacetabular and pelvic involvement around 6%. Primarily managed with chemotherapy, novel agents have been used to improve the life span of patients with myeloma. Surgical methods can be used to address these pathologic lesions when symptomatic. Peri-acetabular reconstruction has high complication rates and are demanding procedures. Non-operative treatment with protected weight bearing and chemotherapeutic treatment of the underlying disease is another option for these symptomatic peri-acetabular lesions, little is known about non-operative treatment of these lesions.

PURPOSES: The purpose of this study was to evaluate multiple myeloma patients treated non-operatively for lytic lesions of the acetabulum in the weight bearing dome and determine their symptom duration, healing time, period of protected weight bearing, chemotherapy regimen, and myeloma subtypes. **PATIENTS:** 7 patients with the mean age of 62 years at presentation were treated non-operatively with weight bearing multiple myeloma lesions of the acetabulum. A retrospective review of these cases was performed. All patients had lesions in the weight bearing dome of the acetabulum.

RESULTS: The average acetabular lesions were 6.5 cm in the largest measured diameter on advanced imaging. The average symptom duration for 6 of the patients whose symptoms resolved with chemotherapy was 6.4 months, 1 patient has yet to have resolution of pain which appears to be secondary to arthritic changes in the hip. The average length of protected weight bearing was 4.5 months. For resolution of the acetabular lesions, 4 patients had complete resolution radiographically which took an average of 9.9 months, whereas 3 of the patients lesions never completely resolved radiographically. 2 patients were newly diagnosed with multiple myeloma at presentation, whereas 5 patients were referred with the diagnosis already established. 6 patients were treated with VTD-PACE chemotherapy protocol and 1 with a VTD and Adriamycin protocol. 6 patients (86%) had IgG Kappa light chain and 1 patient (14%) had IgG Lambda multiple myeloma subtype. None of the patient's acetabular lesions were treated with radiation.

CONCLUSIONS: Whereas many studies have looked at surgical treatment of peri-acetabular multiple myeloma lesions including large peri-acetabular reconstructions and percutaneous acetabuloplasty/cementoplasty, no studies have looked at non-operative treatment of these periacetabular lesions. In conclusion, non-operative treatment of multiple myeloma lesions in the weight bearing surface of the acetabulum is a viable option, with average protecting weight bearing of 4.5 months.

En Bloc Resection and Liberal Use of Adjuvants Lowers Risk of Construct Failure and Local Recurrence in Renal Cell Carcinoma Osseous Metastases

Abstract ID: Paper 055

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PURPOSE: Renal cell carcinoma osseous metastases (RCCOM) present a unique challenge due to advances in medical management, immunotherapy, and the poor response to radiation treatment. As a result, the multi-disciplinary management of RCCOM necessitates a principles based approach and judicious use of adjuvants. The purpose of this study is to examine our experience with RCCOM and provide an overview of management principles through supporting cases.

METHODS: From March 2015 to June 2017, ten patients presenting to a tertiary care orthopedic oncology practice with a diagnosis of RCCOM were identified. Staging was performed with serology, computed tomography of the chest, abdomen, and pelvis and whole body nuclear medicine bone scan. Local advanced imaging included radiographs and magnetic resonance imaging. Histology was confirmed in all cases with preoperative core needle biopsy or with intraoperative frozen section. Timing of surgery was coordinated with the medical oncology team if the patient had been initiated on an anti-angiogenic chemotherapy agent.

RESULTS: The femur was the most common anatomic location identified. Five patients presented with oligometastatic disease and four underwent en bloc resection treated with reverse total shoulder (1), patellectomy (1), distal femur endoprosthesis (1), and vascularized fibula autograft (1) for reconstruction. Adjuvant preoperative embolization was utilized if anatomic location did not allow for the use of a tourniquet. Patients who did not undergo en block resection had a combination of adjuvants including embolization, cryotherapy, curettage, argon beam coagulation, or polymethylmethacrylate. Three patients underwent prior external beam radiation or surgical stabilization at an outside institution and presented because of a failed construct, or local progression of disease. Patients undergoing en bloc resection had no local recurrence or disease progression at median follow-up of one year. No construct failure or local disease progression was observed in patients treated with intra-lesional excision.

CONCLUSION: Pathologic lesions from RCCOM can present a management challenge. It is imperative that treating surgeons recognize the nuances of chemotherapeutic regimens, the poor radiosensitivity of this carcinoma subtype, and the need for a reliable and durable surgical construct. En block resection, particularly in oligometastatic disease can avoid the risk construct failure and decrease local disease recurrence. Liberal use of adjuvants such as embolization, mechanical burring, argon beam coagulation, and polymethyl methacrylate combined with internal fixation can similarly enhance local control and limit complications. By adhering to these principles, early function can be restored providing patients with a durable construct and lasting outcome.

Long-Term Outcome of Hip Arthroplasty in the Setting of Pigmented Villonodular Synovitis (PVNS)

Abstract ID: Paper 056

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INTRODUCTION: Pigmented villonodular synovitis (PVNS) is a rare, exuberant proliferation of the synovium. It is characterized by pain and swelling due to recurrent hemarthroses which can lead to significant joint destruction and morbidity. Arthroplasty has been performed successfully to manage arthrosis in this population; however, these results come from small patient series or case reports. 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: 28 patients were identified at our institution with PVNS that subsequently received hip arthroplasty between 1971-2013. There were 12 males and 16 females with a mean age of 38 years (16-67 years) and mean BMI of 26.8 kg/m². Prior to the arthroplasty, 16 patients (57%) had at least 1 surgical procedure (mean 2, range 1-5) to treat the PVNS. At the time of surgery, 21 (73%) patients had "active" disease, defined by the presence of proliferative synovial tissue and histologically confirmed PVNS. These patients underwent removal of diseased synovium at the time of THA. The disease was defined as diffuse in all patients. The mean follow-up was 14 years (range 2-35 years).

RESULTS: The 10-year disease free-survival was 96%. Recurrence occurred in 2 patients at 1 and 24 years following the arthroplasty. Recurrence was treated with synovectomy and revision arthroplasty in both patients due to component loosening. 20 patients (71%) sustained at least 1 complication, most commonly component loosening (n=13, 46%). Complications resulted in a revision procedure in these 13 patients. At the time of revision, disease recurrence was found in 2 patients. The 10-year revision free survival was 65%. Besides component loosening, the most common complication was dislocation (n=3, 11%).

Prior to surgery the mean Harris Hip score (HHS) was 52 (range 31-65). Following the procedure, there was a significant increase ($P<0.001$) in the mean HHS (76, range 51-90). No patients had a postoperative hip flexion contracture.

CONCLUSION: The results of this study indicate that patients undergoing hip arthroplasty in the setting of PVNS are relatively young; however, it improves patient function with a low rate of local recurrence. Given the high rates of revision surgery, and the young age at the time of surgery, patients with a history of PVNS should be cautioned when undergoing arthroplasty on the elevated risk of subsequent procedures.

Development of a Predictive Nomogram for Survival After Diagnosis of Metastatic Disease of the Humerus

Abstract ID: Paper 057

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PURPOSE: As a non-weight bearing bone the humerus, humerus fractures symptoms may represent late(r) manifestations of metastatic disease as opposed to the spine, pelvis, or lower extremity. This study was undertaken to determine if pathologic humerus were predictive in regards to survival in metastatic disease and, if so, whether or not we could establish a reliable pattern.

METHODS: We queried the electronic medical record of our multi-hospital health system for all patients between January 2010 and January 2016 with an ICD-9 or ICD-10 code for “pathologic fracture of humerus.” Patient charts were retrospectively reviewed to identify potential variables that could affect survival in these patients with specific interest in age, number of comorbidities, smoking status, primary tumor type, number of metastatic lesions, and anatomic location of the metastatic humerus lesion. Cox regression models were used to determine an association between the variables and mortality.

RESULTS: Forty-five patients met our inclusion criteria. Average age at time of diagnosis was 63.67 (59.97-71.92, 95% CI) and average age at time of death was 70.97 years (64.44-75.56, 95% CI). 24 patients had proximal-third humeral fracture, 10 patients with middle-third fractures and 11 patients with distal-third fractures. Patients with lesions in the distal-third of the humerus had higher mortality rates compared to middle-third (HR 31.25, $p = 0.004$) and proximal-third humerus (HR 25.16, $p = 0.005$) lesions. The number of metastatic lesions was shown to have a significant impact on survival (HR 1.40, $p = 0.001$). Due to lack of significant variables in our model, we could not produce a nomogram.

CONCLUSION: The presentation of a pathologic humerus fracture did not appear to predict more indolent or more aggressive disease. Metastatic bone disease and patients subsequent disease course appears not to be predicated based on humeral involvement but differences were noted among location with the humerus and number of lesions present at time of diagnosis of the humerus lesion. These findings may prove useful in counseling patients with metastatic humeral bone disease.

Proximal Femur Fracture Nonunions and Complications Following Radiation Therapy: A Case Series

Abstract ID: Paper 058

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BACKGROUND: Radiation therapy has been an effective and common treatment modality for both soft tissue sarcomas of the thigh as well as non-musculoskeletal tumors including anorectal carcinoma or inguinal lymphatic metastases. While somewhat rare, femur fracture has been a well-documented potential complication after radiation therapy of the thigh as well as pelvis. While some studies have suggested that cancellous bone mechanical properties are not affected by high doses of radiation, there is considerable data to suggest that therapeutic radiation therapy doses adversely affect both the biomechanical properties of the femur as well as its ability to heal and remodel. Others have reported retrospective data that support an increased risk of fracture of the proximal femur after radiation therapy to the thigh and pelvis, particularly if there has been circumferential radiation exposure, higher doses of radiation, periosteal stripping or excision, or concomitant chemotherapy. Our case series provides clinical examples to support the theory that radiation to the pelvis and thigh may lead to increased risk of femur fracture and that subsequent fracture may be at higher risk of complications including nonunion.

METHOD/CASES: We discuss five patients diagnosed with soft tissue sarcoma of the thigh after detailed chart review. All received appropriate treatment of wide resection with concomitant external beam radiation therapy and all suffered complex proximal femur fractures post-radiation therapy. Their cases and results including outcomes, complications, and pearls/pitfalls are described from the experience of a single orthopedic oncology surgeon after decades of practice. We also discuss additional patients who suffered proximal femur fractures post-radiation therapy for reasons other than soft tissue sarcoma. Common reasons for radiation therapy included metastatic disease or intrapelvic malignancy.

RESULTS: Our patient series demonstrates the complex nature of diaphyseal and proximal femur fractures after radiation therapy. Complete cure of their soft tissue sarcoma was achieved for all patients. One patient did expire due to non-oncologic medical comorbidities. Patient population included both pediatric as well as adult/geriatric patients. All patients had previously been diagnosed and treated for varying types of soft tissue sarcoma. Common complications included nonunion, re-fracture and infection.

CONCLUSION: Complications do occur with higher incidence versus fractures in non-radiated regions secondary to both altered bone mechanics and biology and included nonunion, re-fracture, and infection.

Lack of Diversity in Orthopedic Oncology Trials

Abstract ID: Paper 059

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BACKGROUND: Current orthopedic literature suggests that race and ethnicity may be important contributing predictors of functional outcomes. Additionally, race may play a significant role in the survivability of those with primary bone tumors. Despite efforts to emphasize its inclusion, data on racial demographics continue to be frequently omitted from orthopedic randomized clinical control trials (RCTs).

QUESTIONS/PURPOSES: The objective of this study is to evaluate the rate of reporting racial demographics in RCTs in orthopedic oncology in both the United States and worldwide, and to compare the reported racial and ethnic demographics to census data.

PATIENTS AND METHODS: A search of 23 medical and scientific journals was performed using the NCBI PubMed search engine. Only RCTs published between 2005 and 2016 in the field of orthopedic oncology were selected. Multivariate factors were extracted and recorded from these articles. US Census data was derived from www.census.gov, July 1, 2015, census.

RESULTS: Only 14 of 50 RCTs that fulfilled inclusion criteria included any mention of race. Trials conducted in North America were more likely to have included racial information than those conducted in Europe. Studies funded partially or completely through private funds were more likely to include demographic data than those with public funding. The percentage of Caucasians represented in the trials was greater than in the general population, with Hispanics, Blacks, and Asians being notably smaller.

CONCLUSIONS: This review highlights the low rate of reporting racial demographics in RCTs in orthopedic oncology. Studies performed in North America had better inclusion of race and ethnicity; however, representation of minorities was lower than would be expected based on census data. Furthermore, including racial demographics has fallen off in the past five years. Addressing the disparities noted in this review in future randomized clinical trials may potentially benefit the generalizability of results to target populations.

What Are the Incidence and Risk Factors for Anterior Wound Complications Following Harvest of Vertical Rectus Abdominis Myocutaneous (VRAM) Flaps for Sacral Reconstruction?

Abstract ID: Paper 060

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INTRODUCTION: The VRAM flap has been used to reliably reconstruct posterior soft tissue defects following resection of sacral tumors. It is relatively easy to perform and provides ample skin and soft tissue bulk to fill the potential space following sacral resection. Current literature examining the use of VRAM flaps for sacral reconstruction focuses on posterior wound complications, with a paucity of data examining donor site complications related to flap harvest. The purpose of this study is to investigate the incidence of, and risk factors for anterior wound complications following VRAM flap harvest for sacral defect reconstruction following oncologic resection.

METHOD: We identified 88 patients who underwent VRAM flap harvest for reconstruction of a posterior wound following sacral tumor resection from 1994 to 2016. Medical records were reviewed for clinical outcomes as well as postoperative complications. The cohort consisted of 29 females and 59 males, with a mean age of 52 ± 2 years, mean body mass index (BMI) of 27.8 ± 0.8 kg/m², and mean follow-up of 6 years (range 1 to 16 years). Ten patients had a history of diabetes mellitus and 13 were current tobacco users. The mean tumor volume was 465 ± 93 cm³ and the mean flap size was 119 ± 17 cm². All resections were performed through combined anterior and posterior surgical approaches with a curative intent. Mean prone positioning time was 691 ± 43 minutes. Forty-seven patients had a history of neoadjuvant radiotherapy and 28 had intraoperative radiotherapy.

RESULTS: Sixteen (18%) patients sustained an anterior wound complication at a mean 14 ± 8 months postoperatively. Anterior wound complications included wound dehiscence (n=8), abdominal hernia (n=6), and acute fascial dehiscence requiring mesh (n=2). Patients with an anterior wound complication were prone for significantly less time (460 ± 55 vs. 753 ± 51 minutes, $P=0.004$) than those without an anterior complication. There was no difference in VRAM size (113 ± 50 vs. 119 ± 18 cm², $P=0.89$) between patients who sustained an anterior complication and those who did not. Risk factors for anterior wound complications included older (≥ 50 years) age (HR 3.47 [1.26-12.15], $P=0.01$) and obesity (HR 2.79 [1.12-7.21], $P=0.02$). Smoking, diabetes, and history of radiotherapy had no significant influence on the development of anterior wound complications.

CONCLUSION: Anterior wound complications following VRAM harvest have not previously been reported, and were relatively common. Patients with lower total prone positioning time were at increased risk for an anterior wound complication. Older (≥ 50 years of age) and obese patients were also at increased risk of anterior wound complications.

Local Infiltrative Analgesia is Equivalent to Fascia Iliaca Block for Perioperative Pain Management for Prophylactic Cephalomedullary Nail Fixation

Abstract ID: Paper 061

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BACKGROUND: Impending pathologic fractures of the femur due to metastatic bone disease are frequently treated with prophylactic internal fixation. The goals of surgery are to decrease morbidity and mortality associated with pathologic fracture, maintain independence, and improve quality of life. Surgical treatment generates pain which may negatively impact the patients function and outcome. Fascia iliaca block is a regional anesthetic blockade of the femoral nerve designed to minimize intraoperative and postoperative pain. Local infiltrative anesthesia is an injection directly into the surgical site that has demonstrated efficacy as a pain management technique in primary hip and knee arthroplasty. The purpose of this study is to evaluate the analgesic efficacy of a fascia iliaca block (FIB) compared with local infiltrative analgesia (LIA) for patients undergoing prophylactic cephalomedullary nail fixation of impending pathologic femur fractures.

PATIENTS AND METHODS: This is a comparative cohort analysis designed to be a pilot investigation for proof of concept. Cohort 1 (FIB) included 21 patients who received a preoperative FIB and was analyzed retrospectively. Cohort 2 (LIA) included 9 patients treated with LIA administered into all incisions at the conclusion of the procedure and was analyzed prospectively. Primary outcomes assessed were: visual analog scale (VAS) pain scores, narcotic doses administered, and hospital length of stay. Patient characteristics grouped by type of analgesia were compared via two-sample t-tests and Fisher's exact tests. Differences in VAS pain scores, length of stay, and morphine equivalent of narcotic use were assessed with Wilcoxon rank sum.

RESULTS: There were no statistically significant differences between the LIA and FIB groups in the administration of narcotics in the operating room, recovery room, or inpatient floor. There were no statistically significant differences in length of stay or maximum pain scores by VAS at any time point. There was no difference in the number of patients requiring a new narcotic prescription at their two or six-week postoperative follow-up appointment. There were no wound complications in any patient.

CONCLUSIONS: Use of LIA compared with FIB is not associated with an increase in VAS pain scores, narcotic requirement, or length of hospital stay in patients undergoing prophylactic internal fixation of pathologic fractures. Further investigation is warranted in larger numbers to verify these findings. The absence of a difference between these modalities is meaningful because treatment with LIA prevents an additional procedure and is less costly.

Hospital Discharge Within One Day Following Total Joint Arthroplasty in a Veterans Affairs Hospital Does Not Increase Complication and Readmission Rates

Abstract ID: Paper 062

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BACKGROUND: Rising costs associated with total joint arthroplasty continue to place a growing economic burden on the United States healthcare system. Efforts to control costs have included attempts to lower hospital length of stay. However, concerns related to patient outcomes and safety with decreased length of stay abound. The purpose of this study was to investigate whether a policy change resulting in planned early discharge on postoperative day 1 after joint replacement is associated with increased rates of 90-day return to the OR and 30-day readmission and emergency department visits, compared with standard discharge on postoperative day 2 and 3 at a Veteran Affairs hospital.

METHODS: Following retrospective chart review, all patients selected met criteria of one admission event, one joint replaced, and were either discharged on postoperative day 1 (Subgroup 1) or postoperative day 2, or 3 (Subgroup 2). Patients requiring an admission longer than 1 day following implementation of the early discharge protocol were excluded from final analysis. Between January 2, 2013, and September 16, 2016, 206 patients met criteria for inclusion in Subgroup 1, and 241 patients met criteria for inclusion in Subgroup 2. Primary outcomes, patient specific factors, and perioperative factors between the two groups were compared using Wilcoxon-Mann-Whitney tests for continuous variables, and Fisher's exact tests for categorical and frequency data. Statistical significance was established at $p \leq 0.05$.

RESULTS: For the primary outcomes measured, Subgroup 1 had significantly fewer return trips to the operating room ($p=0.043$) and significantly fewer 30 day readmissions ($p=0.033$). Emergency department visits were not significantly different between groups ($p=0.90$). For secondary outcomes measured, patients in Subgroup 1 had lower transfusion rates ($p=0.007$) and were more likely to be discharged home ($p = 0.020$).

CONCLUSIONS: Despite safety concerns, early discharge following total joint arthroplasty appears to be a viable practice for selected patients and did not result in increased reoperation, readmission, or emergency department visits during the perioperative phase of this study. Stratification of patients based on perioperative and patient-specific factors is essential for implementing a successful early discharge program.

Doc: I Can't Sleep: Sleep Disturbances in Orthopedic Trauma Patients

Abstract ID: Paper 063

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PURPOSE: The purpose of this prospective study is to determine the spectrum of sleep disturbances up to 3 months post-injury among trauma patients who had surgery for their orthopedic injuries.

METHODS: Orthopedic trauma patients at a Level 1 Trauma Center were screened at their initial postoperative clinic visit. Inclusion criteria include patients 18-75 and orthopedic injury requiring surgical stabilization. Exclusion criteria included concussion within the last 6 months, history of brain surgery, stroke and/or history of chronic narcotic medication. Eligible patients completed the Pittsburgh Sleep Questionnaire Index (PSQI) and Insomnia Index (IIn) to provide baseline data on sleep patterns before their injury. The patients were queried again at 3 months. Descriptive statistics, Chi square, and paired t tests were utilized to analyze the data.

RESULTS: 66 patients met our inclusion criteria: 44 males and 22 females with an average age of 44 (range:18-74). 46 (70%) patients were under 50 years old. Twenty-eight patients (43%) were injured in a fall, 14 (21%) in motor vehicle accidents (MVA), 12 (18%) in motorcycle accidents (MCC), and 12 (18%) with other causes of injury. There were 12 patients with multiple fractures, 39 lower extremity (hip, femur, tibia, foot/ankle, and periarticular), and 15 upper extremity fractures.

For baseline data, 61% of patients were reporting good sleep quality. At 3 month post injury, there is a significant change ($p<0.05$) in PSQI scores with only 44% of patients reporting good sleep quality. At baseline, 36% of patients reported at least some degree of insomnia, while at 3 months, there is a significant change in IIn scores with 45% of patients reporting some degree of insomnia. There was a significant difference for PSQI and Insomnia Index scores in female patients ($p<0.05$) and patients over 50 from baseline to 3 months. At the 3-months post-injury, 14 patients (21%) were still taking narcotic medications and 8 (12%) were taking sleep aids (prescribed or over the counter). No patients required revision surgery in the first three months.

CONCLUSION: We found a significantly increased number of female patients experiencing poorer sleep quality and increased insomnia. There is also age-related differences, but that could be due to severity of injury, as younger patients had more high energy MVC/MCCs injuries and older patients sustained more falls. This study provides a starting point for doctors to begin viewing postoperative sleep disturbances not only as a real problem but also as an opportunity to improve the recovery process for their patients.

Objective Predictors of Grit, Self-Control, and Conscientiousness in Orthopedic Surgery Residency Applicants

Abstract ID: Paper 064

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BACKGROUND: The qualities of grit, self-control, and conscientiousness are desirable traits for orthopedic surgery residents. Although these can be quantified with validated questionnaires, applicants completing questionnaires as a part of the interview process are subject to desirability bias making objective assessment difficult. The purpose of this paper was to identify objective predictors of grit, self-control, and conscientiousness that are not subject to applicants' desirability bias.

METHODS: Three major scales (grit, self-control, and conscientiousness) and three sub-scales (consistency of interest, perseverance of effort, and ambition) were anonymously assessed in applicants. Scores were correlated with objective demographics used in the application process such as: age, sex, board scores, college athletic experience, military experience, number of publications, desired future practice setting, number of additional degrees, and Alpha Omega Alpha (AOA) status.

RESULTS: The 455 (50.8%) applicants who completed the assessment demonstrated a mean grit score of 4.12 (70th percentile for the general population). AOA status, additional degrees, and number of publications did not predict any of the desired attributes. Grit score increased with age ($p < 0.001$), but decreased with rising board scores ($p = 0.004$). Prior collegiate athletic experience predicted higher scores for: grit ($p < 0.001$), consistency of interest ($p = 0.007$), perseverance of effort ($p = 0.006$), and self-control ($p = 0.019$). Female applicants demonstrated more grit ($p = 0.044$), consistency of interest ($p = 0.003$), and conscientiousness ($p = 0.029$) than males. Applicants with military experience had increased ambition ($p = 0.033$) and conscientiousness ($p = 0.001$). Those desiring a career in academics demonstrated greater consistency of interest ($p = 0.014$), ambition ($p = 0.019$), and self-control ($p = 0.006$) compared to applicants desiring private practice or hybrid careers.

CONCLUSIONS: Overall, orthopedic applicants possess higher levels of grit than the general public, and a number of objective variables reliably predicted high levels of the studied attributes. The most notable include: collegiate athletics, female sex, military experience, desire for academic career, and age. This information may prove informative for programs looking to evaluate these critical qualities in potential residents.

MAOA SECOND PLENARY SESSION
April 20, 2018

Efficacy of Anti-Resorptives at Maintaining the Beneficial Effects of Teriparatide

Abstract ID: Paper 065

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INTRODUCTION: Teriparatide, a hallmark treatment for osteoporosis, has been shown to increase bone mineral density (BMD) and bone turnover. This can be measured using BMD scans, N-terminal propeptide of type-1 collagen (P1NP) for bone formation, and C-terminal telopeptide (CTX) for bone resorption. This study examines the effects of the two most common antiresorptive drugs prescribed following two years of teriparatide treatment: zoledronic acid and denosumab. The purpose of this study is to quantify the beneficial effects of teriparatide and compare the ability of each antiresorptive drug to maintain the effects.

METHODS: Ninety-four patients with prior fragility fractures were identified from a bone health clinic associated with a Level 1 trauma center. All of the study participants completed two years of treatment with teriparatide between 2008-2013 followed by two years of treatment with zoledronic acid, denosumab, or no treatment. After excluding patients with insufficient laboratory data, 64 patients remained for analysis in this retrospective cohort study. Bone mineral density was measured in the lumbar spine and femoral neck.

RESULTS: Following completion of teriparatide, patients who were started on denosumab showed the most substantial increase in bone mineral density after two years of treatment; lumbar spine: $+4.94\% \pm 8.2\%$, femoral neck: $+5.68\% \pm 6.7\%$. Patients on zoledronic acid remained relatively stable; lumbar spine: $1.75\% \pm 4.1\%$, femoral neck: $-1.05\% \pm 4.0\%$. Patients who discontinued treatment had a decrease in BMD at both locations; lumbar spine: $-1.56\% \pm 7.7\%$, femoral neck: $-1.12\% \pm 4.2\%$.

CONCLUSIONS: In this study, teriparatide demonstrated a strong ability to increase BMD during the 2-year treatment course. Following completion of teriparatide, patients who were started on denosumab showed the most significant increase in bone mineral density at both the lumbar spine and femoral neck. Patients who elected to discontinue osteoporosis treatment experienced a decline in BMD putting them at higher risk for recurrence of fragility fractures. This study demonstrates the importance of anti-resorptive treatment following teriparatide along with the need for a prospective trial in order to best assess the differences these drugs have on

both BMD and refracture rates in osteoporosis patients.

KEYWORDS: DXA, Anabolics, Antiresorptives, Osteoporosis, Biochemical markers of bone turnover

Operative and Non-Operative Management of Osteochondritis Dissecans in the Knee of Skeletally Immature Patients: Progression Rates to Osteoarthritis and Arthroplasty at Mean 14-Year Follow-Up

Abstract ID: Paper 066

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PURPOSE: Osteochondritis dissecans (OCD) is a bone disorder commonly affecting the knee of pediatric populations. Due to its relatively low incidence, it has traditionally been difficult to study OCD's effect on the natural history of the knee. The purpose of this study was to evaluate the rate of osteoarthritis in patients with juvenile OCD and to determine predisposing factors for initial operative management as well as long-term knee pain and conversion to total knee arthroplasty (TKA).

METHODS: A large, geographically-based database of over 500,000 patients was reviewed to identify patients with OCD by International Classification of Diseases 9 (ICD9) code. Charts were hand verified to confirm physician-documented presence of OCD and document demographics and natural history of lesions including operation and conversion to TKA.

RESULTS: 95 skeletally immature patients (70 males, 25 females) with OCD lesions diagnosed at a mean age of 13 years (range: 7-16) were followed for a mean of 14 years (range: 2-40). 53 patients (56%) had OCD treated operatively and 42 patients (44%) were treated non-operatively.

Patients treated operatively demonstrated wider lesions on lateral radiographs (18.6 mm versus 14.6 mm, $p < 0.01$), and a greater proportion of progeny bone concavity (42% versus 8%, $p = 0.02$) compared to patients treated non-operatively. At final follow-up, 13 patients at a mean age of 30-years-old noted symptomatic knee pain. 8 (15%) of the patients treated operatively had knee pain as compared to 5 patients (12%) in the non-operative group. Three patients, one treated operatively and two treated non-operatively, converted to TKA at a mean of 37 years following OCD diagnosis at a mean age of 52 years.

CONCLUSION: A large portion of patients with skeletally immature OCD lesions develop early knee arthritis and subsequently undergo TKA. These rates are higher than that established in the general population and it appears that initial operative intervention, although likely biased by lesion characteristics, does not lead to clear benefit in prevalence of knee pain or conversion to TKA at mid- to long-term follow-up.

Early Mobilization After Basal Joint Arthroplasty: Preliminary Clinical Results

Abstract ID: Paper 067

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INTRODUCTION: Traditional rehabilitation for basal joint arthroplasty involves prolonged thumb immobilization prior to initiating motion and strengthening. We hypothesize that early motion following basal joint arthroplasty is safe and will result in equivalent clinical outcomes to traditional rehabilitation.

METHODS: Patients undergoing ligament reconstruction and tendon interposition (LRTI) were randomized to one of two rehabilitation protocols. All patients were immobilized following surgery in a thumb-spica plaster splint for 2 weeks. The accelerated rehabilitation group (Group 1) was then transitioned into a removable neoprene thumb CMC-wrap with activity as tolerated, while the traditional rehabilitation group (Group 2) were placed in a thumb-spica cast or splint to be worn fulltime for an additional 4 weeks. Patients were examined preoperatively and at 6 and 12 weeks postoperatively. Outcome measures included the Disabilities of the Arm, Shoulder, and Hand (DASH) score, a visual analog scale for pain (VAS), pinch and grip strength and thumb range of motion. A descriptive analysis was run on data for both groups along with a repeated measure analysis of variance to compare the two groups at each time point with significance set at $P < 0.05$.

RESULTS: Twenty-seven patients were randomized, 13 in group 1 and 14 in Group 2. There were no statically significant differences between the two groups with respect to age, preoperative DASH, VAS, pinch or grip strength, or thumb CMC range of motion. There were no statistically significant differences between the two groups with respect to postoperative DASH, VAS, pinch or grip strength, or thumb range of motion at both six and 12 weeks postoperatively. There were no intraoperative complications.

DISCUSSION AND CONCLUSION: Early (12-week) outcomes suggest that early mobilization of patients following CMC arthroplasty does not compromise clinical results, with no significant difference demonstrated in DASH, VAS score, thumb strength, or range of motion. Longer-term data and increased sample size will determine the lasting effects of accelerated rehabilitation. An accelerated rehabilitation protocol may offer equivalent clinical results with earlier return to pre-morbid function than traditional rehabilitation.

Culturing Periprosthetic Joint Infection: Number of Samples, Growth Duration, and Organisms

Abstract ID: Paper 068

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Dr. Kheir is the recipient of the Dallas B. Phemister, M.D. Physician in Training Award.

BACKGROUND: Due to difficulty isolating microorganisms in periprosthetic joint infection (PJI), current guidelines recommend that 3-5 intraoperative samples be cultured and maintained for 3-14 days based on minimal literature. We aimed to investigate: (1) the optimal number of culture samples and growth duration to diagnose PJI and (2) the microbiology profile at our institution.

METHODS: This was a retrospective review of 711 patients (329 hips, 382 knees) with PJI that met Musculoskeletal Infection Society criteria from 2000-2014. A total of 2,290 aerobic and anaerobic cultures were analyzed. A manual chart review was performed to collect demographic, surgical, and microbiological data. Microbiology profiles were trended. Logistic regression analysis was performed to determine statistical significance.

RESULTS: Obtaining 5 samples provided the greatest yield positive cultures for diagnosing PJI. The percentage of positive cultures overall was 62.6%, and stratified by organism type was as follows: antibiotic-resistant (80.0%), *Staphylococcus aureus* (76.0%), gram-positive (68.3%), Coagulase-negative staphylococcus (CNS, 63.3%), non-resistant (58.9%), gram-negative (58.9%), *Pseudomonas* (52.0%), variant PJI organisms (28.8%), *P. acnes* (20.0%), and *E. coli* (8.0%). While most organisms were cultured in 5 days or less, 10.8 days were needed for isolation of *P. acnes*, 6.6 days for variant PJI organisms, and 5.2 days for CNS. At 3 days of incubation, only 42.1% of cultures turned positive compared to 95.0% at 8 days. There was a significant decrease over time in gram-positive PJIs ($p=0.022$) and an increase in culture-negative PJIs ($p=0.046$).

CONCLUSION: The optimal number of cultures and growth duration was dependent on the type of organism. This study provides evidence that five samples should be obtained and held for at least 8 days given the fact that the type of organisms is likely to be unknown at the time of surgery in many cases.

MAOA BREAKOUT SESSION #6
FOOT AND ANKLE
April 20, 2018

Percutaneous Posterior to Anterior Screw Fixation of the Talar Neck: Soft Tissue Structures at Risk

Abstract ID: Paper 069

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INTRODUCTION: Fractures of the talar neck and body can be fixed with percutaneously placed screws directed from anterior to posterior or posterior to anterior. The latter has been found to be biomechanically and anatomically superior. Percutaneous pin and screw placement poses anatomic risks for posterolateral and posteromedial neurovascular and tendinous structures. The objective of this study was to enumerate the number of trials for proper placement of two parallel screws and to determine the injury rate to neurovascular and tendinous structures.

METHODS: Eleven fresh frozen cadaver limbs were used. 2.0 mm guide wires from the 5.0-mm headless cannulated set were percutaneously placed (under fluoroscopic guidance) into the distal posterolateral aspect of the ankle. Malpositioned pins were left intact to allow later assessment of soft tissue injury. The number of guide wires needed to achieve an acceptable positioning of the implant was noted. After a layered dissection from the skin to the tibia, we evaluated neurovascular and tendinous injuries, and measured the shortest distance between the closest guide pin and the soft tissue structures, using a precision digital caliper.

RESULTS: The mean number of guide wires needed to achieve acceptable positioning for 2 parallel screws was 2.91 ± 0.70 (range, 2 - 5). The mean distances between the closest guide pin and the soft tissue structures of interest were: Achilles tendon, 0.53 ± 0.94 mm; flexor hallucis longus tendon, 6.62 ± 3.24 mm; peroneal tendons, 7.51 ± 2.92 mm; and posteromedial neurovascular bundle, 11.73 ± 3.48 mm. The sural bundle was injured in all the specimens, with 8/11 (72.7%) in direct contact with the guide pin and 3/11 (17.3%) having been transected. The peroneal tendons were transected in 1/11 (9%) of the specimens. The Achilles tendon was in contact with the guide pin in 6/11 (54.5%) specimens and transected in 2/11 (18.2%) specimens.

CONCLUSION: The placement of posterior to anterior percutaneous screws for talar neck fixation is technically demanding and multiple guide pins are needed. Our cadaveric study showed that important tendinous and neurovascular structures are in close proximity with the guide pins and that the sural bundle was injured in 100% of the cases. We advise performing a formal small posterolateral approach for proper visualization and retraction of structures at risk.

Regardless, adequate patient education about the high risk of injury from this procedure is crucial.

Dimensions and Potential Violation of the Lateral Malleolar Fossa with Lateral Distal Fibular Plate Fixation

Abstract ID: Paper 070

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PURPOSE: A previously undescribed pitfall of lateral distal fibular locking plates is the risk of violation of the lateral malleolar fossa (MF). Violation of this fossa with distal screws may not be apparent intraoperatively on fluoroscopy, and has the potential to irritate surrounding structures and impinge against the subtalar joint. The purpose of this study was to (1) identify the incidence of screws placed at risk of violating the MF with lateral distal fibular locking plates, (2) identify technical or fracture factors that may be related to potential violation of the MF, and (3) describe the dimension and characteristics of the MF of the distal fibula on computed tomography.

METHODS: All cases utilizing a lateral distal fibular locking plate for a fibula fracture from December 2012 to December 2015 (n = 365) at a single institution were retrospectively reviewed. Patient age, sex, BMI, diagnosis, procedure, and intraoperative films were reviewed. Screws that violated the lateral cortical density corresponding to the malleolar fossa on the internal rotation mortise view of the ankle were identified as “at-risk” screws. Available preoperative CT scans were reviewed (n = 69) to measure malleolar fossa dimensions.

RESULTS: 115/365 patients (31.5%) were identified as having distal fibular screws “at-risk” of malleolar fossa violation. There were no statistically significant differences between MF violation and non-violation groups in terms of age (53.1 vs. 51.2, $p=0.31$), sex ($p=.74$), open fracture ($p=0.38$), syndesmotomic fixation required ($p=0.28$), and Weber classification ($p=0.07$). MF dimensions on CT scan were measured for (mean [SD], [min-max]): height: 12.96 mm (2.09) (9.0-17.3 mm), width: 7.52 mm (1.37) (4.2-10.4 mm), and depth: 8.32 mm (1.59) (5.3-11.8 mm). The mean ratio of the MF width to total fibular width was 0.46 (0.3-0.65, SD: 0.07), while the mean ratio of the MF depth to total fibular depth was 0.42 (0.28-0.58, SD: 0.07). There was a small, but statistically significant, difference in dimensions of patients with screws at risk of MF violation compared to those without (MF height: 13.77 vs. 12.56, $p = 0.02$; MF width: 7.98 vs. 7.30, $p = 0.05$; MF to fibula width ratio: 0.49 vs. 0.44, $p = 0.01$; MF to fibula depth ratio: 0.43 vs. 0.42, $p = 0.05$).

CONCLUSIONS: MF violation is a previously unreported, but potentially prevalent pitfall of lateral distal fibular locking plate use. Surgeons should be aware of the size of the MF and should exhibit caution when placing screws in the distal locking holes during fibula fixation to avoid prominent hardware.

Percutaneous Home Run Screw Fixation in Ankle Fusion: Technical Aspects and Soft Tissue Structures at Risk

Abstract ID: Paper 071

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INTRODUCTION: Ankle fusion is a common procedure that can be achieved using various fixation methods. One method, described as the “homerun screw technique”, uses a percutaneously placed augmentation screw that spans the posterolateral tibia to talar neck. Proper positioning of the homerun screw is technically demanding and usually involves multiple attempts that risk injury to surrounding neurovascular structures. The objective of this project is to enumerate the number of trials for proper screw placement while also determining the injury rate to neurovascular structures at risk.

METHODS: Eleven fresh frozen cadaver limbs were used. With neutral positioning of the ankle, 3.2 mm guide wires from a 7.0 mm headless cannulated set were percutaneously placed under fluoroscopic guidance into the distal posterolateral aspect of the leg. Malpositioned pins were left intact to later allow assessment of neurovascular injury. The number of guide wires needed to achieve an acceptable positioning of the implant was noted. After a layered dissection from the skin to the tibia, we evaluated neurovascular and tendinous injuries, and measured the shortest distance between the closest guide pin and the soft tissue structures, using a precision digital caliper.

RESULTS: The mean number of guide wires needed to achieve acceptable positioning of the implant was 2.09 (range, 1 - 4). The mean distances between the closest guide pin and the soft tissue structures of interest were: Achilles tendon, 6.90 ± 3.74 mm; peroneal tendons, 9.65 ± 3.99 mm; sural neurovascular bundle 0.97 ± 1.93 mm; and posteromedial neurovascular bundle 14.26 ± 4.56 mm. The sural bundle was in contact with the guide pin in 5/11 (45.5%) specimens and transected in 3/11 (27.3%) specimens.

CONCLUSION: The placement of percutaneous home run screws in ankle fusion surgery is technically demanding, often necessitating placement of multiple guide pins. Our cadaveric study showed that important tendinous and neurovascular structures are in close proximity with the guide pins and that the sural bundle is injured in approximately 73% of the cases.

Isolated Gastrocnemius Recession is an Effective Treatment for Chronic Plantar Fasciitis

Abstract ID: Paper 072

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BACKGROUND: Limited ankle dorsiflexion and gastrocnemius contracture are recognized etiologic factors for plantar fasciitis. Gastrocnemius recession (GR) may be a simple, yet effective surgical treatment option in the treatment of chronic plantar fasciitis. However, studies in the current literature are limited by sample size and follow-up time. To our knowledge, our study represents the largest cohort available measuring functional outcomes following isolated GR in the treatment of chronic plantar fasciitis.

METHODS: We conducted a retrospective chart review of patients who underwent isolated GR for plantar fasciitis at a single institution. Procedures were performed by a single surgeon, from 2011-2017. Patients who underwent concurrent procedures or had any additional co-diagnoses involving the foot and ankle were excluded from the study. Clinical outcomes were evaluated based on postoperative visual analogue scale (VAS), short form-36 (SF-36), and foot function index (FFI) scores. Statistical analysis was performed using a paired sample t-test.

RESULTS: A total of 79 patients were included, 51 females (64.6%) and 28 males (35.4%), with a mean age of 45.8 (range, 20-68) years and BMI of 34.4 ± 7.8 kg/m². The average follow-up time was 27.1 ± 14.3 months. There was a 20% (16/79) complication rate, with 15 of the complications being transient sural neuritis and the other being a minor wound complication. VAS scores improved from an average of 6.4 preoperatively to 2.4 at the time of final follow-up ($p < 0.0001$). The mean FFI score was 28.3%. Preoperative and postoperative SF-36 scores were measured among eight different characteristics related to general health and well-being. There was a statistically significant improvement in SF-36 postoperative pain scores from 35.2 to 60.6 ($p = 0.0082$). There were no significant differences in pre- and postoperative SF-36 scores for physical functioning, limitations due to physical health, limitations due to emotional problems, energy and fatigue, emotional well-being, and social functioning.

CONCLUSION: Isolated gastrocnemius recession represents an effective treatment for chronic plantar fasciitis following failure of nonoperative management. Our study found that after an average follow-up time of 27 months, patients had significant pain relief and good functional outcomes.

Paired Samples Analysis of Isolated Gastrocnemius Contracture in Patients with Foot and Ankle Pathology

Abstract ID: Paper 073

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INTRODUCTION: Prior studies have demonstrated that patients with foot and ankle pain have an associated isolated gastrocnemius contracture (decrease in ankle dorsiflexion). It remains unclear if this is a casual, or a causal relationship. The purpose of the current study is to report validated ankle dorsiflexion in both legs of patients with unilateral foot and ankle pain to provide some insight into the relationship between an isolated gastrocnemius contracture and foot and ankle pain. Our hypothesis was that patients presenting with foot and ankle pain would have similar measured ankle range of motion in both ankles despite having unilateral foot and ankle symptoms.

METHODS: Institutional review board approval was obtained and a prospective case-control study was performed. We utilized a previously validated device to measure ankle range motion and isolated gastrocnemius contracture in 21 patients diagnosed with foot and ankle pathology. Measurements were repeated three times on each side with the knee extended to isolate the effect of the gastrocnemius muscle. We additionally performed a clinical examination and goniometer measurement of ankle range of motion. Patient history and demographics were also obtained.

RESULTS: Mean dorsiflexion was 12.1° in the extremity with foot and ankle pathology compared to a mean of 15.4° in the unaffected limb, which was a statistically significant difference, ($p < 0.05$). The device was used three times on each patient with no significant difference between measurements, ($p > 0.05$). The difference in dorsiflexion was significantly less utilizing a goniometer than using the validated device, which may be due to measurement technique and external landmarks, ($p < 0.001$).

CONCLUSION: Previous studies have demonstrated a relationship between foot and ankle pathology and an ipsilateral isolated gastrocnemius contracture. It is unclear if the isolated gastrocnemius contracture is the cause of foot and ankle pathology, or vice-a-versa. This study provides evidence that patients with unilateral foot or ankle pain do not have symmetric ankle range of motion, which has several clinical implications. First, it is possible that foot and ankle pain may cause ipsilateral loss of ankle range of motion due to gait compensations or other abnormalities. Second, it makes intuitive sense that if foot and ankle pain is causing a loss in range of motion, then the contralateral side may be uninvolved. Third, further studies should be performed to study the relationship between and mechanism by which this difference develops in the setting of foot and ankle pain.

Intraoperative Syndesmotic Instability Test: A Novel Alternative Technique

Abstract ID: Paper 074

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INTRODUCTION: Precise diagnosis of distal tibiofibular syndesmotic injury is challenging. Tibiofibular clear space identified on radiographic imaging is considered the most reliable indicator of the injury as it is not significantly influenced by tibial rotation. A clear space greater than 6 mm above the tibial plafond is suggestive of injury. The Cotton test, is the most widely used intraoperative technique to evaluate the syndesmotic integrity. We propose an alternative technique using a 3.5 mm blunt cortical tap. Our method is simple and provides a quantitative evaluation of the syndesmosis.

METHODS: Nine fresh-frozen above-knee cadaveric specimens were used with mean age of 79 years. First, a 2.5 mm hole was drilled percutaneously on the lateral aspect of the distal fibula; in position for possible placement of a syndesmotic screw or suture button. A 3.5 mm cortical tap was then threaded in the hole. For each specimen, three sequential fluoroscopic mortise images were taken. The first image was with the syndesmotic ligaments intact and no force applied to the tap (intact, non-stressed). On the second, with the ligaments intact, the cortical tap was advanced until its blunt tip was pushing against the lateral tibial surface, thus providing a tibiofibular separation force (intact, stressed). The third one was acquired after same stress was applied but all syndesmotic ligaments were released (injured, stressed). Tibiofibular clear space was measured twice, 1 cm above the tibial plafond, by two independent viewers. Non-stressed and stressed measurements were compared by Student's t-test. Intra- and inter-observer agreements were evaluated by intraclass correlation coefficient (ICC). P-values <.05 were considered significant.

RESULTS: We found excellent intra-observer (ICC 0.92) and inter-observer (0.87) agreement following the imaging assessment. The mean values for the tibiofibular clear space were: 3.3 ± 1 mm in the intact, non-stressed ankles; 3.62 ± 1.12 mm in the intact, stressed ankles; and 6.64 ± 1.34 mm in the injured, stressed ankles. Significant differences were found in the paired comparison between the groups ($p < .05$). Our novel syndesmotic instability test has demonstrated a 66% sensitivity, 75% negative predictive value, 100% specificity, and 100% positive predictive value in diagnosing syndesmotic instability.

CONCLUSION: The test was able to demonstrate significant differences in the tibiofibular clear space when comparing normal ankles without stress, normal ankles with stress, and complete injury of the syndesmotic ligaments with stress. It represents a viable, simple, quantitative, and low-cost alternative to the most used Cotton test. Furthermore, the hole that is made for this test can be used in the event that fixation is necessitated.

Risk Factors for Unplanned Above Knee Amputation After Initial Transtibial Amputation in the Perioperative Period

Abstract ID: Paper 075

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INTRODUCTION: The primary aim of this study was to determine patient factors associated with an increased risk of unplanned AKA after primary transtibial amputation (TTA) in the perioperative period.

MATERIALS AND METHODS: Patients under 90 years of age who underwent TTA as the primary procedure between 2011 and 2015 were identified (n=9,229) from the American College of Surgeons National Surgical Quality Improvement Program® (ACS-NSQIP) database.

RESULTS: In this cohort of 9,229 patients, the overall rate of unplanned AKA after initial TTA was 3% (277 out of 9,229). Age over 65 years (OR 1.7, 95% confidence interval [CI]: 1.4-2.2), female sex (OR 1.3, 95% CI: 1.01-1.7), smoking (OR 1.5, 95% CI: 1.2-2.0), history of hypertension (OR 1.9, 95% CI: 1.3-2.7), and history of chronic obstructive pulmonary disease (OR 1.7, 95% CI: 1.2-2.4) were significantly predictive of unplanned AKA in the 30-day perioperative period. Factors that were associated with a lower rate of unplanned AKA were BMI >30 kg/m² (OR 0.7, 95% CI: 0.6-0.96) and diabetes (OR 0.6, 95% CI: 0.5-0.7). In contrast, level of functional dependence before surgery (OR 1.1, 95% CI: 0.8-1.4), steroid use (OR 1.1, 95% CI: 0.7-1.8), BUN >20 mg/dL (OR 1.3, 95% CI: 1.0-1.6), creatinine >1.2 mg/dL (OR 1.0, 95% CI: 0.8-1.3), white blood cell count >10,000 cells/μL (OR 1.3, 95% CI: 1.0-1.6), dialysis (OR 1.2, 95% CI: 0.9-1.6), and history of congestive heart failure (OR 1.0, 95% CI: 0.6-1.6) were not correlated with significantly increased or decreased odds of AKA.

DISCUSSION AND CONCLUSION: Patient age, gender, smoking status, history of hypertension, and chronic obstructive pulmonary disease may be important predictors of AKA after failure of initial TTA in the perioperative period. Interestingly, diabetes was associated with reduced odds of unplanned AKA. However, significantly increased odds of any reoperation within the perioperative period after TTA were observed in patients with diabetes (OR 2.8, 95% CI: 2.4-3.1). This may suggest that diabetic patients undergo more conservative procedures after failed TTA during the 30-day perioperative period before an AKA is attempted, or they may not be stable enough during the 30-day postoperative period to undergo another major amputation. Further study is needed to evaluate rates of subsequent AKA and outcomes of AKAs beyond the first 30 days after primary BKA. However, these results may assist in determining baseline preoperative risk assessment for unplanned AKA in the perioperative period after primary TTA.

Scoring Mental Health Quality of Life with the SF-36 in Patients with and without Diabetes Foot Complications

Abstract ID: Paper 076

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INTRODUCTION: Diabetic foot disorders significantly impact patient-reported physical quality of life as demonstrated by lower physical component summary (PCS) scores on the SF-36. However, previous efforts have failed to demonstrate significant reduction in mental component summary (MCS) score, an overall measure of mental health quality of life. The aim of this study was to examine if using orthogonal and oblique factor analysis detect changes in health-related quality of life (HRQoL) differently in patients with diabetes on the SF-36 survey.

MATERIAL AND METHODS: Three hundred patients were surveyed using the Short Form-36 (SF-36) and the Foot-Ankle-Ability-Measure (FAAM) to assess HRQoL. One hundred fifty-five patients had diabetic foot complications (DFC) and 145 patients had diabetes without foot complications. The SF-36 PCS and MCS scores were calculated using scoring coefficients determined by orthogonal and oblique rotation principle component analyses.

RESULTS: Among the SF-36 subscales, patients with DFCs reported significantly worse Physical Function ($p<0.00001$), Role Physical ($p<0.00001$), Bodily Pain ($p=0.003$), General Health ($p<0.00001$), Vitality ($p=0.015$), Social Function ($p=0.0004$), Role Emotional ($p=0.036$), and Mental Health ($p=0.034$). These differences were reflected in both orthogonal ($p<0.00001$) and oblique ($p<0.00001$) PCS scores which were lower in patients with DFCs. Despite lower Mental Health subscale scores in patients with DFCs, no differences were observed in orthogonal MCS scores ($p=0.156$). In contrast, the difference in the Mental Health subscale responses was corroborated by oblique MCS scores ($p=0.0005$). Interestingly, PCS scores determined orthogonally and obliquely did not differ significantly among patients in either group. However, orthogonal MCS scores were significantly higher than oblique MCS scores in patients without DFCs ($p=0.005$) and with DFCs ($p=0.0004$). Similar findings were also observed with the shorter 12-item SF-12 survey.

DISCUSSION AND CONCLUSION: Poorer physical function leads to significantly greater orthogonal MCS scores than if determined by oblique scoring coefficients. Despite significantly lower Mental Health subscale scores in patients with DFCs, orthogonal MCS scores failed to demonstrate a statistical difference. Physical Function, Bodily Pain and General Health are weighted more negatively in orthogonal coefficients when calculating MCS score. Therefore, MCS scores tend to be higher in patients with poor physical function. Although oblique scoring coefficients may address this issue, further study is necessary to confirm whether the oblique MCS scores accurately represent the mental health impact of patients with diabetic foot disease.

Greatest Fears for Patients with Diabetic Foot Problems

Abstract ID: Paper 077

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INTRODUCTION: According to the CDC, approximately 10% of adults in the U.S. are living with diabetes with a further 35% having prediabetes. Diabetes related foot complications are common, leading to significant morbidity and mortality. The purpose of this study was to determine to what degree patients presenting with foot pathology fear these complications.

METHODS: A 32-question survey was developed to assess patients' fear of eight different complications using a Likert-type scale (1 to 5). English or Spanish speaking patients over the age of 18 with diabetes presenting to outpatient clinics at both the university hospital and the county hospital were asked to fill out the survey during their visit. Participants were then subcategorized into those with diabetic foot problems (Charcot foot, ulcers and infections) and those without foot complications (tendonitis, flatfeet, etc.) to allow for comparison and statistical analysis.

RESULTS: When comparing patients with and without diabetic foot disease, there were no significant differences with regard to gender, duration of diabetes, type of diabetes, end-stage renal disease, or BMI. Patients with diabetic foot disease were younger and more likely to use insulin, have neuropathy, and have peripheral artery disease. Patients with diabetic foot disease reported more significant fear of blindness, foot infection, minor amputation, and major amputation than patients without diabetic foot disease. When looking specifically at patients with diabetic foot disease, the risk of foot infection ($p<0.05$), minor amputation ($p<0.05$), and major amputation ($p<0.05$) were significantly more feared than blindness, death, dialysis, heart attack, or stroke. There were no significant differences in the fear of foot infection, minor amputation, or major amputation in those patients with diabetic foot disease.

CONCLUSION: Patients with diabetic foot disease fear foot-related complications (infection, major amputation, and minor amputation) and blindness significantly more than death, heart attack, stroke, or dialysis. There was no significant difference in the fear of foot infection, minor amputation, and major amputation in patients with established diabetic foot disease. Physicians who treat patients with diabetes-related foot complications should recognize that patients are concerned about infection and limb loss more than death.

Surgical Outcomes Following Achilles Tendinopathy Treated with Isolated Gastrocnemius Recession

Abstract ID: Paper 078

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BACKGROUND: As many as 25% of patients with Achilles tendinopathy will fail conservative treatment, eventually requiring surgery. Several operative techniques are used, though it is unclear which is best. Of the data that is currently available in the literature, follow-up length is extremely limited. In this study, we present functional outcomes, complications, and rate of failure associated with gastrocnemius recession when used for Achilles tendinopathy with a long-term cohort follow-up.

METHODS: Retrospective chart review from 2011 to 2017 of patients that underwent isolated gastrocnemius recession for primary repair of insertional and/or noninsertional Achilles tendinopathy. Exclusion criteria included concomitant procedures, co-diagnosis of Achilles rupture or plantar fasciitis, and lack of adequate follow-up. Outcome measures including visual analogue pain scale (VAS) score, foot function index (FFI) score, short form-36 (SF-36) scores, complications, and failures were recorded. Initial SF-36 have been collected for all patients, though the results are not included in our results at this time due to time constraints. 24% (6/25) patients completed a VAS, FFI, and SF-36 on final follow-up. A paired sample t-test was used to analyze improvement in VAS score.

RESULTS: There were 25 patients (17 female) included with mean age of 54.4 (range 40-78) years and mean BMI of 36.2 ± 7.7 kg/m². Mean follow-up time was 12.8 ± 11.4 months. There was a 16% (4/25) complication rate, with 3 sural neuritis and 1 incisional neuroma. There was one failed operation due to ongoing pain that was treated successfully with FHL transfer and Haglund lesion resection. On final follow-up, mean final FFI score was 20.32% (42.7/210) and the mean VAS score improved from 6.4 preoperatively to 1.8 postoperatively ($p=.005$). On average, all patients felt that their health was about the same as it was one year ago. Final SF-36 forms were scored among eight different health characteristics: physical functioning 60.8, roll limitations due to physical health 81.3, roll limitations due to emotional problems 94.4, pain 57.9, energy/fatigue 69.2, emotional well being 70.7, social functioning 89.6, and general health 61.7.

CONCLUSION: Achilles tendinopathy treated with isolated gastrocnemius recession results in excellent outcomes, measured by a significant reduction in VAS score, satisfactory final FFI score, final SF-36 scores, low complication rate, and minimal reoperation rate. We suggest that surgeons consider using this procedure for the primary treatment of Achilles tendinopathy as it is simple, quick, and leaves other more demanding surgical options available if revision is necessitated.

Comparison of Total Ankle Replacement and Ankle Arthrodesis During the Recovery Period

Abstract ID: Paper 079

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INTRODUCTION: For end-stage ankle arthritis, two reliable surgical procedures exist, ankle arthrodesis and total ankle replacement. Several comparative studies have shown similar clinical results between the two procedures at intermediate-term follow-up (2 to 6 years). Despite this comparative literature, no studies have been dedicated to determining which, if either, of the two procedures allows better function and pain during the recovery period (the first year following the procedure). This information would be especially beneficial to patients for whom a more difficult recovery would be particularly adverse, such as elderly patients or patients with medical comorbidities.

METHODS: This is a single site retrospective case-control study. Patient-Reported Outcomes Measurement Information System (PROMIS) scores had been completed by patients at the orthopedic foot and ankle clinic at each visit since October 2014 until March 2017. Patients who had undergone either a total ankle replacement or an ankle arthrodesis during that timeframe were reviewed to determine their level of pain, function, and depression using their PROMIS data. Complications were noted. Exclusion criteria included Charcot neuroarthropathy, revision procedures, and inadequate data.

RESULTS: 62 patients (38 total ankle replacements, 24 ankle arthrodeses) met inclusion criteria and had appropriate PROMIS data pre- and postoperatively. Groups were not statistically different preoperatively regarding their pain and function. Using mixed repeated measures analysis, both groups significantly improved compared to baseline for pain and function. Patient function was significantly better throughout the first one year postoperatively for the total ankle replacement group compared to arthrodesis ($p=0.01$). This difference was most marked during postoperative months 7-12 ($p=0.005$), with a trend favoring replacement during months 4-6 ($p=0.056$) and no difference during months 0-3 ($p=0.8$). During the first year overall, there was no difference in pain ($p=0.17$), but a difference was found favoring replacement during months 7-12 ($p=0.028$). Depression scores were different between groups preoperatively, a difference that did not change during the postoperative period ($p=0.93$). Complications were too few to statistically analyze their effects on PROMIS data.

CONCLUSION: Using PROMIS data, there was no difference between total ankle replacement and ankle arthrodesis during the first 6 months postoperative. However, total ankle replacement patients had significantly better improvement in function and pain during the second 6 months after surgery. This data may be helpful when counseling patients regarding the postoperative course of these procedures.

Treatment of Hallux Rigidus: Allograft Interpositional Arthroplasty vs. Arthrodesis

Abstract ID: Paper 080

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INTRODUCTION: Hallux Rigidus (HR) is a deformity of the first metatarsophalangeal (MTP) joint characterized by pain with motion, decreased joint space, subchondral sclerosis, osteophyte formation, and limited patient activity. HR is second only to Hallux Valgus in chief concern of the great toe. HR is the most common arthritis of the foot and can be degenerative, post-traumatic, inflammatory or idiopathic.

Surgical treatments include cheilectomy, Keller osteotomy, implant-based interpositional arthroplasty, synthetic cartilage, or arthrodesis (fusion). Arthrodesis or interpositional arthroplasty are generally recommended for severe HR diagnoses. Arthrodesis is often a salvage procedure for failed interpositional arthroplasty and end-stage hallux rigidus. Furthermore, 1st MTP arthrodesis has demonstrated a 13% nonunion rate in the literature. Hallux MTP interpositional arthroplasty maintains joint motion, while MTP arthrodesis limits mobility.

We hypothesize 1st MTP biologic allograft interpositional arthroplasty without bone resection will demonstrate equivalent results in subjective scores while maintaining joint motion compared to 1st MTP fusion. The primary objective was to compare change in visual analogue scale (VAS) scores between patients with 1st MTP allograft interpositional arthroplasty and patients with 1st MTP fusion.

METHODS: A retrospective cohort study was performed on patient data collected from Spectrum Health, Metro Health, and Orthopedic Associates of Michigan from 2002 to 2015. Inclusion criteria included: >18 years of age, painful hallux rigidus, decreased 1st MTP motion and joint space, and osteophytes. Exclusion criteria included: ipsilateral peripheral neuropathy, previous MTP surgery, inflammatory arthritis, non-English speaking individuals, interphalangeal arthritis, and simultaneous ankle/hindfoot fusion procedure.

A modification, approved by the IRB, allowed the patients to be contacted via phone and participate in a prospective cohort study. Updated VAS and AOFAS scores were obtained through these phone calls. This was implemented to increase the follow-up time to determine how well patients are functioning years after their procedures. The average total follow-up time for MTP interpositional arthroplasty was 174 weeks, while average total follow-up time for MTP arthrodesis was 122 weeks.

RESULTS: There was no statistically significant difference in improvement as measured by VAS between the two groups (4.08 + 2.02 for MTP interpositional arthroplasty and 4.54 + 3.64 for

MTP arthrodesis, $p = 0.592$).

CONCLUSIONS: Pain improvement is similar for patients that undergo MTP interpositional arthroplasty and those that undergo MTP arthrodesis. There is no significant difference in pain between groups, while interpositional arthroplasty maintains greater joint mobility, which is an important goal of many patients.

Percutaneous Tendon Achilles Lengthening: What Are We Really Doing?

Abstract ID: Paper 081

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INTRODUCTION: Percutaneous Achilles tendon lengthening (TAL) is a common procedure used to address equinus contracture of the foot. A triple hemisection technique has become popular due to its ease and efficiency. Several studies evaluate the surgical outcomes of this procedure, but currently, descriptive anatomical studies are lacking. The objective of the study was to evaluate the accuracy of performing Achilles tendon percutaneous hemisections, the amount of tendon excursion in the tensile gaps of the cuts after forced dorsiflexion and the improvement in the range of motion for dorsiflexion of the ankle joint.

METHODS: Eight fresh-frozen above-knee cadaveric specimens were used, with a mean age of 79 (range, 54-88) years. A percutaneous triple hemisection of the Achilles tendon (proximal, intermediate, and distal), per the Hoke technique, was performed in all specimens. Maximum dorsiflexion angle of the ankle was evaluated pre- and post-procedure with a goniometer. After proper dissection, the relative width of the cuts was noted and the tendon excursion, represented by the displacement in the tensile gaps, was measured with a precision digital caliper.

RESULTS: The overall relative width of the percutaneous cut was $51.70\% \pm 17.60$ of the Achilles tendon diameter, $44.30\% \pm 13.59$ for the proximal cut, $51.47\% \pm 18.86$ for the intermediate cut, and $59.31\% \pm 18.45$ for the distal cut. Tendon excursion averaged 13.58 ± 4.00 mm for the proximal cuts, 11.74 ± 4.40 mm for the intermediate cuts, and 7.78 ± 4.11 mm for the distal cuts. One cadaver had a complete rupture of the Achilles tendon and was excluded from the excursion data analysis.

The mean range of motion for dorsiflexion was $7.71^\circ \pm 4.39^\circ$ pre-procedure and $25.57^\circ \pm 4.89^\circ$ post-procedure. The dorsiflexion angle increased a mean of 17.9° following TAL. One cadaver was noted to have an accessory soleus tendon which did not get properly hemisectioned along with the adjacent Achilles tendon; nevertheless the Achilles tendon had tensile gap excursion that was comparable to the other samples.

CONCLUSION: Our cadaveric study demonstrated that the percutaneous triple hemisection of the Achilles tendon (TAL) provided successful lengthening and increased excursion of the tendon, resulting in 18° of improvement in the dorsiflexion angle of the ankle. The technique was found to be accurate in achieving a hemisection of the Achilles tendon, even with the presence of an accessory soleus tendon. Complete ruptures are possible complications.

MAOA BREAKOUT SESSION #7
SPORTS/SHOULDER
April 20, 2018

The Role of Triggering Receptor Expressed on Myeloid Cells (TREM) Proteins in Juvenile Rotator Cuff Tendon Regeneration

Abstract ID: Paper 082

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INTRODUCTION: Tendon injuries can be a significant cause of pain and disability if appropriate healing does not occur. Juvenile patients have excellent regenerative capacity following tendon injury, while the tendon in adults often responds to injury with disorganized scar that lacks the normal structure and function of mature tendon tissue. Triggering receptor expressed on myeloid cells (TREM-1 and 2) have been found to be an important regulator of pathologic inflammation in various human tissues. However, their role as a regulator in tendon regeneration has not been defined.

METHODS: The infraspinatus tendon of 21 eight-week-old male Sprague Dawley rats was tenotomized and allowed to retract after a non-absorbable marking suture was placed in the lateral-most aspect of the tendon. Young rats were utilized because of their regenerate tissue capacity analogous to juvenile patients. The animals were then sacrificed at time intervals of 5 days, 10 days, and 24 days and the healing tissue and musculotendinous unit was harvested. The contralateral non-operative side was utilized as a control. Histological and immunohistochemical analysis was then performed to quantify tissue structure, Collagen I, Collagen III, TREM-1, and TREM-2 content.

RESULTS: Bridging tendon-to-tuberosity tissue was found in all operative shoulders at all time points. Disorganized tendon tissue, defined as a high Collagen III to Collagen I ratio, was found early in the postoperative period and the Collagen III to I ratio subsequently decreased as time progressed. A significant increase in TREM-1 and TREM-2 was observed in the operative shoulders compared to the control. Decreasing TREM-1 and TREM-2 content mirrored the maturing Collagen III to Collagen I ratio as the study progressed.

CONCLUSION: TREM-1 and TREM-2 may serve as important mediators in tendon tissue regeneration. Understanding the pathophysiological effects of TREM-1 and TREM-2 expression and manipulation may be a useful therapeutic target to enhance tendon healing, regenerative treatments of tendinopathy, and tissue engineering applications.

Risk Factors for Admission After Shoulder Arthroscopy

Abstract ID: Paper 083

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INTRODUCTION: Shoulder arthroscopy is one of the most commonly performed orthopedic procedures. These surgeries are typically performed on an outpatient basis. Occasionally patients will require an unplanned overnight stay. An understanding of the incidence and potential risk factors will assist surgeons in determining which patients may be susceptible to unplanned admission after surgery.

METHODS: All shoulder arthroscopy surgeries performed at a single institution over the 10-year study period were retrospectively reviewed. Only elective procedures were included. Causes for admission were assessed. A 2-1 control-case matching system was utilized; controlling for surgeon and surgery dates within 1 month. Univariate analysis was performed to identify differences between those patients that were admitted after surgery and those who were not. Multivariate logistic regression was performed to identify variables associated with admission when all other variables were controlled for.

RESULTS: 5598 shoulder arthroscopies were performed over the 10-year study period. 234 patients were admitted for an admission rate of 4.18%. The most common organ system responsible for admission was the respiratory system (OSA monitoring, postoperative desaturation, aspiration). On multivariable analysis, chronic obstructive pulmonary disease (COPD) (OR 2.73 [95% CI 1.51,4.95]), diabetes (OR 2.11 [95% CI 1.28,3.48]) obstructive sleep apnea (OSA) (OR 1.90 [95% CI 1.13,3.21]) were individually found to be risk factors for admission when all other significant results were controlled for. Body mass index (BMI) (OR 1.04 [95% CI 1.01,1.07]), age (OR 1.02 [95% CI 1.01,1.04]), operative time (OR 1.01 [95% CI 1.00, 1.01]) were also individually found to be risk factors for admission with the odds ratio representing the increased risk for a single unit increase (age 1 year, operative 1 minute, and BMI 1 unit). Anesthesia type, namely regional block with sedation, was found to decrease risk compared to general anesthesia and regional block with general anesthesia (OR 0.44 [95% CI 0.30, 0.63]).

CONCLUSION: COPD, OSA, diabetes, increasing age, increasing BMI, and increasing operative time were all individually found to be risk factors for admission after shoulder arthroscopy. The absence of general anesthesia was found to decrease the risk of admission after shoulder surgery. Patients, particularly those being operated on at an ambulatory surgery center, should be carefully screened for risk factors in order to be prepared for an unplanned admission after shoulder arthroscopy.

Safety and Efficacy of Hyperosmolar Irrigation Solution in Shoulder Arthroscopy

Abstract ID: Paper 084

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BACKGROUND: A hyperosmolar irrigation solution has been reported to be safe and have potential benefits for use during shoulder arthroscopy in an animal model study. In this study, the clinical effects of a hyperosmolar solution were compared with a standard isotonic solution when used for shoulder arthroscopy.

METHODS: A prospective, double-blind, randomized controlled trial was performed to compare isotonic (273 mOsm/L) and hyperosmolar (593 mOsm/L) irrigation solutions used for arthroscopic rotator cuff repair. Primary outcomes focused on the amount of periarticular fluid retention based on net weight gain, change in shoulder girth, and pain. All patients were tracked through standard postsurgical follow-up to ensure no additional complications arose. Patients were contacted at 1 year to assess American Shoulder and Elbow Surgeon score, visual analog scale pain score, and the Single Assessment Numeric Evaluation shoulder scores.

RESULTS: Fifty patients (n = 25/group) were enrolled and completed the study. No statistically significant differences were noted between cohorts in demographics or surgical variables. The hyperosmolar group experienced significantly less mean weight gain (1.6 ± 0.82 kg vs. 2.25 ± 0.77 kg; $P = .005$), significantly less change in shoulder girth ($P < .05$), and a significantly lower immediate postoperative visual analog scale pain score ($P = .036$). At 1 year postoperatively, the differences between groups for American Shoulder and Elbow Surgeons, visual analog scale pain, and Single Assessment Numeric Evaluation were not significant ($P > .2$).

CONCLUSION: A hyperosmolar irrigation solution provides a safe and effective way to decrease periarticular fluid retention associated with arthroscopic rotator cuff surgery without any adverse long-term effects. Use of a hyperosmolar irrigation solution for shoulder arthroscopy has potential clinical benefits to surgeons and patients.

Level of evidence: Level I; Randomized Controlled Trial; Treatment Study

Bactericidal Efficacy of Hydrogen Peroxide on Propionibacterium Acnes

Abstract ID: Paper 085

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INTRODUCTION: Propionibacterium acnes has been increasingly recognized as one of the most common causative organisms responsible for postoperative shoulder infection. The purpose of this study was to examine the bactericidal efficacy of hydrogen peroxide (H₂O₂). We hypothesize that use of H₂O₂ would reduce the bacterial burden of P. acnes.

MATERIALS AND METHODS: The effect of hydrogen peroxide was assessed by testing the bactericidal effect, time course analysis, colony forming unit (CFU) growth inhibition, and minimum bactericidal concentration. P. acnes was plated on trypticase soy agar with defibrinated sheep blood (DSB) at 37°C in an anaerobic gas mixture (GasPak). Trypticase soy broth with DSB was inoculated with single colonies, grown for 48 hours and adjusted to 2x10⁸ CFU/mL in 0.85% NaCl (saline) solution. To assess the bactericidal effect bacteria were treated for 30 minutes with 0%, 1%, 3%, 4%, 6%, 8%, or 10% H₂O₂ prepared in saline or water and compared to commercially available 3% topical H₂O₂ solution and assayed for viability with LIVE/DEAD BacLight Kit (Molecular Probes). To determine CFU inhibition bacteria were plated as lawn in agar for 24 hours. 100 µl of water, saline, 3% H₂O₂ in water, 3% H₂O₂ in saline or 3% topical solution were placed at the center of the plate and cultured for 3 days. For time course analysis bacteria were treated with either water, or saline (controls), 3% H₂O₂ in water, 3% H₂O₂ in saline or 3% topical solution for 5, 10, 15, 20, and 30 minutes and assayed for viability. Results were analyzed with one-way ANOVA compared to 3% topical solution with p<0.05.

RESULTS: The minimum bactericidal concentration of H₂O₂ after 30 minutes of incubation is 7.89% for H₂O₂ prepared in saline and 4.64% for H₂O₂ prepared in water. However, the 3% topical solution was significantly more effective compared to the 8% H₂O₂ prepared in saline (p<0.001) and concentrations up to 4% prepared in water (p<0.001). The controls of both saline and water alone showed no reduction of bacteria. After 5 minutes of exposure, all mixtures of H₂O₂ reduced the percentage of live bacteria, with topical solution being most effective. Maximum growth inhibition was achieved with topical 3% H₂O₂.

CONCLUSION: The inexpensive topical solution of 3% H₂O₂ demonstrated superior bactericidal effect as observed in the minimum bactericidal concentration, time course, and CFU inhibition assays. These results support the use of H₂O₂ before surgical skin preparation prior to shoulder surgery to achieve eradication of P. acnes for the skin.

Does Preoperative Doxycycline Reduce Propionibacterium Acnes in Shoulder Arthroplasty?

Abstract ID: Paper 086

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BACKGROUND: Propionibacterium acnes (P. acnes) is the most common bacteria associated with infection after shoulder arthroplasty (SA). This bacteria can be cultured from the skin after standard preoperative skin preparation and antibiotics. The purpose of this study was to determine whether adding preoperative intravenous doxycycline reduces the incidence of P. acnes culture positivity from the skin and deep tissues at the time of prosthetic joint implantation during SA.

METHODS: This is a randomized clinical trial. An a priori power analysis determined a sample size of 56 patients. Patients undergoing primary anatomic or reverse total SA were randomized to receive either standard peri-operative cefazolin or a combination of doxycycline and cefazolin. Tissue cultures were then taken from the skin edge, superficial dermal tissue, and glenohumeral joint. All cultures were held for 14 days to allow for P. acnes detection. Groups were compared to determine if the addition of doxycycline reduced the rate of culture positivity.

RESULTS: 56 patients were enrolled and randomized. There were no differences between group demographics. 21/56 patients (38%) had at least one positive culture for P. acnes, with no significant difference between cefazolin alone (10/27 patients [37%]) and the combined doxycycline and cefazolin group (11/29 patients [38%]) ($p=0.99$). The highest numbers of culture positive samples were taken from the skin (30%), followed by dermal tissue (20%), and glenohumeral joint (5%). Those patients with positive cultures were younger (64.9 ± 7.7 vs. 69.4 ± 7.7 , $p=0.041$), and tended to be male (16/21 76% vs. 17/35 49%, $p=0.053$) with lower Charlson Comorbidity Index scores (3.35 ± 1.3 vs. 4.09 ± 1.4 , $p=0.051$). There were no differences in BMI ($p=0.446$) or arthroplasty type (8/27 for anatomic SA vs. 13/29 for reverse SA, $p=0.280$). There were no doxycycline-related adverse events.

CONCLUSIONS: In this randomized clinical trial, doxycycline did not significantly decrease P. acnes positivity in the skin, dermis, and glenohumeral joint. P. acnes positivity was observed in 38% of patients, with higher rates in younger, male patients, and those with fewer medical comorbidities.

Sternoclavicular Joint Palpation Pain: The Shoulder's Waddell's Sign?

Abstract ID: Paper 087

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INTRODUCTION: Pain is a complex and subjective reality and can be magnified by nonorganic or nonanatomic sources. Multiple studies have demonstrated a correlation between psychological factors and patients' perceptions of musculoskeletal pain and disability. Additionally, nonorganic findings as part of the physical examination are well and long recognized. The purpose of this study was to analyze the relationship between a shoulder examination test, palpation of the sternoclavicular joint (SCJ), and psychosocial conditions including chronic pain, depression, and anxiety.

METHODS: From June 2016 until October 2016, new patients of two sports/shoulder fellowship trained surgeons at an academic practice were screened for study enrollment. After their consent patients were given a set of five surveys (PCS, PHQ-2, PSEQ, QuickDASH, SPADI) to complete. The physician then completed a comprehensive standardized physical examination with the examining physician being blinded to the patient's survey responses. Palpation of the SCJ was done with the examiner's thumbs and accompanied with questioning of, "Does this hurt?" If a positive pain response was given, clarification as to the correct side of the pain was made.

RESULTS: A total of 132 patients were enrolled and completed the surveys and physical examination. Twenty-six patients (19.7%) reported SCJ pain with SCJ palpation. Patients with and without confirmed pain on SCJ palpation had significantly different ($p < 0.001$) mean scores of all five surveys. Review of past medical histories between the two groups identified a significantly increased prevalence of chronic pain (46.2 % vs. 23.6% in SCJ negative patients) and mental health disorders (38.5% vs. 11.9 % in SCJ negative patients), such as anxiety and depression, in SCJ positive patients.

CONCLUSIONS: Patients with pain upon SCJ palpation have higher scores on various psychological surveys than those who denied pain upon palpation, indicating that a portion of their pain was stemming from a nonorganic source. Inclusion of SCJ palpation during a routine shoulder/upper extremity physical examination may improve selection of treatment options for patients.

Patient Perceptions of Surgeon Reimbursement for Rotator Cuff Repair

Abstract ID: Paper 088

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INTRODUCTION: Previous studies in the arthroplasty, spine, and shoulder and elbow literature have shown that patients perceive Medicare reimbursement to surgeons to be much higher than current reimbursement schedules. Furthermore, when presented with the actual reimbursement amounts, patients typically feel that surgeons should be paid more to perform these procedures. The purpose of this study was to evaluate patient perceptions of surgeon reimbursement for various rotator cuff repair (RCR) procedures.

METHODS: This study surveyed 153 patients who presented to an orthopedic sports medicine clinic. Patients were surveyed and asked to estimate how much they thought surgeons were reimbursed by Medicare for RCR procedures, as well as how much they thought surgeons should be reimbursed. T-tests were conducted to compare these responses. These procedures, which were described briefly in the survey, included arthroscopic repair of a simple tear, arthroscopic repair of a massive tear, open repair of an acute tear and open repair of a chronic tear. Patients were then given the actual Medicare reimbursement rates for these procedures and asked if they felt surgeons should be reimbursed that amount.

RESULTS: The mean reimbursement that patients felt surgeons should receive for arthroscopic repair of a rotator cuff tear was \$5,645 which was significantly more than what they estimated surgeons were actually reimbursed by Medicare (\$3,644, $P<.001$). Patients also felt that surgeons should be reimbursed more than they estimated they were for arthroscopic repair of a massive tear (\$8,066 vs. \$4,694, $P<.001$), open repair of an acute tear (\$8,428 vs. \$4,548, $P<.001$), and open repair of a chronic tear (\$8,902 vs. \$4,639, $P<.001$). While patients felt that surgeons should be reimbursed significantly more for an arthroscopic repair of a massive tear as compared to a simple tear (\$8,066 vs. \$5,645, $P<.001$), no other differences were observed between procedures. When given the actual Medicare reimbursement rates for arthroscopic repairs, 71% of patients felt reimbursement should be higher for simple tears (\$1,052) and 84% felt it should be higher for massive tears (\$1,052). For open repairs, 86% of patients felt reimbursement should be higher for repair of acute tears (\$816) and 88% felt it should be higher for repair of chronic tears (\$846). Forty-four percent of patients disagreed that surgeons will continue to accept Medicare patients and 68% of patients felt that surgeons were not fairly reimbursed. Seventy-eight percent of patients surveyed in this study were unaware of the global period.

CONCLUSION: Consistent with previous literature, patients perceive Medicare reimbursement for RCR to be much higher than what surgeons are actually reimbursed. This effect was observed across all RCR procedures. When presented with actual reimbursement rates, most patients feel that surgeons should be reimbursed at higher rates than they are. As we enter a bundled care environment, price transparency is increasingly important, particularly in the elective surgery setting. This study indicates an increasing need for patient education on how their healthcare costs are allocated.

The Location and Extent of Pathology in Chronic Biceps Tendinopathy Patients Undergoing Subpectoral Biceps Tenodesis

Abstract ID: Paper 089

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PURPOSE: To evaluate preoperative MRI, anatomic, and histologic findings in the proximal biceps tendon of patients with symptomatic chronic, refractory biceps tendinopathy undergoing subpectoral biceps tenodesis.

METHODS: 16 patients with chronic, refractory biceps tendinopathy were treated with open subpectoral biceps tenodesis. Patients requiring rotator cuff or SLAP repair were excluded. Preoperative MRI was performed and the tendon was graded into 4 categories: normal tendon, increased signal, tendon splitting, incomplete/complete tear. Intraoperative anatomic findings were recorded. The removed portion of the biceps tendon was split into 3 segments; zone 1 (proximal): 0 -3.5 cm from the labral insertion, zone 2 (mid): 3.5- 6.5 cm and zone 3 (distal): 6.5- 9 cm, and evaluated for histology. Tenosynovium adjacent to the tendon was assessed histologically. Inflammatory changes within each segment were graded using a modified Bonar score and tested for the presence of CD3 and CD79a cells. ANOVA and Pearson correlations were performed for statistical analysis.

RESULTS: Preoperative MRI demonstrated no significant differences in tendon appearance between zones 1-3. Intraoperative findings included non-specific degenerative SLAP tears or mild/moderate bicep tenosynovitis in all cases. There were no cases of gross bicep tear/subluxation in this cohort. Significantly ($p < 0.048$) more severe histopathology scores were noted for tendon in zones 1 (9.5 ± 2.7) and 2 (10.2 ± 2.6) compared to zone 3 (8.0 ± 2.0) ($p < .05$). Inflammatory tenosynovium scores demonstrated weak correlation with tendon changes in zone 1 ($r = 0.08$), zone 2 ($r = 0.03$), or zone 3 ($r = 0.1$).

CONCLUSION: In patients with chronic refractory proximal biceps tendinopathy undergoing open subpectoral tenodesis, MRI and intraoperative assessment did not demonstrate significant structural abnormalities despite overt histopathologic changes demonstrated in the proximal biceps. Severity of tendon histopathology was more pronounced in the proximal and mid portion of the tendon.

Objective Demonstration of Poor Sleep Quality in Patients with Rotator Cuff Tears

Abstract ID: Paper 090

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BACKGROUND: The role of sleep dysfunction in patients with rotator cuff tears has been the subject of multiple studies in recent years. These studies have utilized subjective questionnaires and as their primary endpoints. Though many patients complain of poor quality sleep, no study to date has provide an objective assessment of sleep quality in patients with rotator cuff tears.

PURPOSE: To objectively assess the quality of sleep in patients with full-thickness rotator cuff tears and compare these patients to historical controls.

STUDY DESIGN: Prospective Cohort, Level 3.

METHODS: A total of 20 patients with full-thickness rotator cuff tears diagnosed either by MRI or ultrasound were enrolled in a prospective study. Patients were provided with an Actiwatch Spectrum Plus, a highly validated device that utilizes actigraphy to provide objective assessments of total sleep time (TST), sleep onset latency (SOL), wake after sleep onset (WASO), and sleep efficiency. Patients wore this device for two consecutive weeks to allow for detailed analysis. The results were compared to historical data obtained from the general population, a cohort of 969 healthy adults aged 57-97.

RESULTS: Two patients were noncompliant with use of the activity monitor and were excluded. Average TST in this cohort was (mean \pm SD) 365.95 ± 53.75 minutes; average SOL was 30.68 ± 19.27 minutes; average WASO was 78.36 ± 34.92 minutes; average sleep efficiency was $74.36\% \pm 8.13\%$. Normal parameters for TST, SOL, WASO, and sleep efficiency are 391 ± 50 minutes, 21 ± 14 minutes, 43.6 ± 18.7 minutes, and $78.4\% \pm 7.4\%$. Total sleep time, sleep onset latency, wake after sleep onset, and sleep efficiency were all significantly worse ($p = 0.0357$, $p = 0.0223$, $p < 0.0001$, and $p = .0040$, respectively).

CONCLUSION: The early data from this study demonstrate objectively poor sleep quality in patients with rotator cuff tears. Our study suggests that these patients have difficulty falling asleep, have a shorter duration of sleep, and wake up often throughout the night, resulting in an overall decrease in sleep efficiency. Further studies can attempt to evaluate the effect of treatment in improving sleep quality in this patient population.

Meniscal Repair in Patients Age 40 and Older: A Systematic Review of 11 Studies and 157 Patients

Abstract ID: Paper 091

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PURPOSE: Patients over 40 years of age frequently present with symptomatic meniscal tears which are often treated with meniscectomy rather than repair based on the age of the patient. The purpose of this review is to evaluate published outcomes related to rates and risk factors for failure of meniscus repairs in patients age 40 or older.

METHODS: A systematic search was performed, and 225 meniscus repair outcome studies on adults were identified in the English literature. Included studies reported either individual patient data with at least one patient age ≥ 40 years or summary data with all patients age ≥ 40 years. Failure rates were determined based on previously reported risk factors (regardless of age) including concomitant anterior cruciate ligament reconstruction (ACLR), tear location, and tear pattern.

RESULTS: Meniscus repair outcomes for 157 patients from 11 studies were included (130 inside-out repairs and 27 all-inside repairs). The overall failure rate was 10% (15/157) and ranged from 0-23% in individual studies with more than 1 patient age ≥ 40 years. One comparative study of patients over versus under age 40 were identified, with no difference in failure rates between groups. Most tears were peripheral tears with avascular extension (9% overall failure rate) or without avascular extension (9% failure). Among studies that reported tear pattern, overall failure rates for vertical-longitudinal or bucket handle tears were 9% and complex and/or horizontal tears were 23%. Repairs with concomitant ACL reconstruction had a 5% overall failure rate versus 15% in ACL intact patients.

CONCLUSION: Meniscus repair failure rates in patients age 40 and older are comparable to rates quoted for younger patients. Age over 40 should not be viewed as a contraindication to meniscus repair.

Level of evidence: IV; systematic review of level III-IV studies

Key Words: meniscus repair, age 40 and older, meniscus injury, inside-out repair

Increased Rate of Reoperation with Tibial Tubercle Osteotomy That Includes Distalization as Compared to Anteromedialization

Abstract ID: Paper 092

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OBJECTIVES: Tibial tubercle osteotomy (TTO) is a treatment option for patients with patellofemoral malalignment combined with refractory patella instability and/or patellofemoral chondral disease. TTO may be performed to improve lateral maltracking (anteromedialization [AMZ]), to correct patella alta (distalization [DTZ]), or in combination. There is a paucity of information comparing TTO with or without distalization of the tuberosity. The purpose of this study was to assess the rate of reoperation following TTO in distinct cohorts of patients undergoing either isolated AMZ versus osteotomy that includes DTZ.

METHODS: After obtaining Institutional Review Board approval, patients undergoing TTO performed by a single surgeon between 2012-2016 were identified. Based on surgeon preference, patients were separated into cohorts that underwent TTO with either isolated AMZ or osteotomy including DTZ. Patient groups were analyzed for demographic differences in age, American Society of Anesthesiologists (ASA) score, BMI, surgical time, concomitant procedures, and tourniquet use. Retrospective chart review of prospectively collected data was performed with primary endpoints including the incidence of reoperation for infection, post-surgical stiffness, or failure of fixation (fracture, nonunion) requiring revision TTO. Results were analyzed statistically.

RESULTS: A total of 57 patients underwent 63 primary TTOs between 2012-2016. 56% (35/63) of the surgical encounters underwent isolated AMZ of the tibial tubercle and 44% (28/63) of osteotomies included DTZ. There were no statistically significant differences in age ($p=0.18$), surgery time ($p=0.35$), BMI ($p=0.84$), ASA score ($p=0.86$), concomitant procedures ($p=.23$), tourniquet use ($p>.05$), or thromboembolic events ($N=0$) between AMZ and DTZ groups. The overall rate of reoperation after TTO was 9.5% (6/63). In the isolated AMZ cohort, there was a 5.7% (2/35) reoperation rate (post-surgical infection $N=1$, post-surgical stiffness $N=1$, failure of fixation $N=0$). In the DTZ cohort, there was a 14.3% (4/28) reoperation rate (post-surgical infection $N=0$, post-surgical stiffness, $N=0$, failure of fixation $N=4$). There was a significant difference in the TTO revision rate for the DTZ group (4/28) vs. the AMZ group (0/35) ($p=0.03$).

CONCLUSION: In this series of 63 TTOs, the reoperation rate of DTZ was more than twice that of the AMZ group (14.3% vs. 5.7%). TTO including DTZ had a significantly higher rate of failure of fixation (fracture, nonunion) requiring revision TTO or tubercle fragment excision as compared to TTO with AMZ. ($N=4$ vs. $N=0$; $p=.0.03$). Information regarding the relative risk of reoperation and revision may assist the surgeon in preoperative patient counseling and post-surgical rehabilitation for patients undergoing different types of TTO.

Femoral Nerve Block at Time of ACL Reconstruction Affects Rehabilitation and Quadriceps Strength

Abstract ID: Paper 093

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INTRODUCTION: Femoral nerve block has known short-term effects on quadriceps strength after ACL reconstruction, though it is unclear whether lasting deficits occur. The purpose of our study is to evaluate whether FNB administration at time of ACL reconstruction causes residual quadriceps strength deficits after adjusting for other clinically relevant causes of quadriceps atrophy including chronic or concomitant injuries.

METHODS: 234 patients who underwent primary ACL reconstruction were enrolled (65% male, 35% female, mean age 24.0 SD 8.4). All patients underwent functional strength testing toward the end of knee rehabilitation (mean time to evaluation 5.7 months SD 2.4 after surgery). The association between the use of a femoral nerve block and isokinetic strength as well as recurrent injury risk was evaluated with adjustment for relevant confounders including demographics, time from injury to surgery, concomitant meniscus or cartilage injuries, and time from surgery to functional evaluation.

RESULTS: Recurrent ACL injury of the reconstructed knee occurred in 7.8% of total patients and ACL injury of the contralateral knee occurred in 3.9%. A >80% limb symmetry index was achieved by 65% of patients and >90% in 36% at the initial functional evaluation. Patients who received a femoral nerve block had mean 5% greater residual deficit in fast isokinetic quad strength testing (300 degrees/second) versus patients without a block (86% without block, 81% with block). Odds failing to reach a >90% limb symmetry index were two-fold higher with a femoral nerve block (OR 2.18 CI 1.24, 3.92, $p=0.007$). There was a trend toward higher odds of contralateral ACL injury with use of a femoral block (OR 3.96 CI 0.89, 27.9; $p=0.07$) but no effect on ipsilateral ACLR failure ($p=0.31$).

CONCLUSION: Our data suggests that femoral nerve blocks may exacerbate muscle atrophy post-ACL reconstruction and lead to persistent strength deficits and decreased functionality. The 2-fold increase in failure to reach minimum limb symmetry index standards is significant due to its role in the evaluation of readiness for return to sport. The increased limb asymmetry may lead to the favoring of the uninjured limb, thus altering joint loading mechanics and potentially correlating with the increase in contralateral ACL injury in patients receiving FNB. Therefore, the risks involved in femoral nerve blocks may outweigh their potential anesthetic benefit.

MAOA BREAKOUT SESSION #8
TRAUMA
April 20, 2018

Predicting 30-Day Mortality in Elderly Patients Undergoing Hemiarthroplasty for Femoral Neck Fractures: A Nomogram

Abstract ID: Paper 095

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PURPOSE: Femoral neck fractures in the elderly are increasingly common as a result of a growing geriatric population. One-year mortality rates following these fractures have been reported as high as 35% in the literature. While medical optimization and operative management have greatly reduced the mortality associated with non-operative treatment of these fractures, some patients still die after undergoing surgery. The purpose of this study was to identify predictors of 30-day mortality in elderly patients who underwent operative treatment of femoral neck fractures with hemiarthroplasty to subsequently generate a predictive nomogram to determine the probability of mortality.

METHODS: This was a retrospective evaluation using data from the American College of Surgeons-National Surgical Quality Improvement Program database collected from 2005 to 2014. The database was queried using the Current Procedural Terminology code for hip hemiarthroplasty (27125). A total of 5,918 patients 60 years of age or older who had undergone hemiarthroplasty were identified. Patient demographics, comorbidities, ASA classification, preoperative functional status, and surgical variables were analyzed between patients who experienced 30-day mortality and those who did not. T-tests and Chi-Square tests were used to analyze continuous and categorical variables, respectively. Logistic regression was then used to generate a multivariate model of significant predictors of mortality. A nomogram was subsequently generated to predict the probability of mortality based on the presence of these significant risk factors.

RESULTS: Patient comorbidities that were found to be predictive of 30-day mortality following hemiarthroplasty included advanced age (odds ratio (OR)=1.04, 95% confidence interval (CI):1.02-1.06), male sex (OR=1.80, CI:1.39-2.32) and underweight BMI(<18.5 kg/m²) (OR=1.55, CI:1.15-2.10). Certain comorbidities including disseminated cancer (OR=3.43, CI:2.14-5.50) and heart failure within 30 days prior to surgery (OR=2.22, CI:1.44-3.42) were also predictive of mortality. Functional status of either partial or total dependence (OR=2.04, CI:1.57-2.64) and ASA grade 3 (OR=2.54, CI:1.42-4.53) or ASA grade 4 and 5 (OR=5.64, CI:3.11-10.24) were also found to be predictive of mortality. Weight loss >10% in the 6 months prior to surgery was found to be approaching significance (P=0.07) and thus was also included in the nomogram given its clinical relevance and ease of ability to screen for.

CONCLUSION: We have generated a tool based on simple, easily-identifiable risk factors,

demographics, and comorbidities that can help to predict elderly patients who will experience mortality within 30 days of surgery. While not intended to influence management, this nomogram was developed to serve as a counseling tool for physicians to use with patients and their families to better assist them in understanding perioperative mortality risk. Further studies are needed to externally validate this nomogram.

Evaluation of Racial Disparities in Outcomes Following Hip Fracture Surgery

Abstract ID: Paper 096

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INTRODUCTION: Hip fractures place a significant strain on the American health care system. While national trends indicate a decline in both the incidence and mortality following hip fractures, these gains may not be universally shared among races and socioeconomic groups. We sought to investigate the isolated effect of race on hip fracture outcomes.

METHODS: The National Surgical Quality Improvement Program (NSQIP) data file from 2005 to 2014 was used to identify all patients with a diagnosis of hip fracture by the International Statistical Classification of Diseases and Related Health Problems, 9th Revision (ICD-9). All patients undergoing surgical intervention (i.e., hemiarthroplasty, total hip arthroplasty, plate and screw fixation, intramedullary nailing) were included in analysis. Patients were stratified by race (i.e., White, Black, Asian, or Hispanic). Primary outcomes included Center of Medicare and Medicaid Services (CMS) reportable complications, unplanned readmission, delay to surgery, total hospital length of stay, discharge destination, and death. Propensity score matching in a 5:1 fashion was used to compare cohorts (i.e., White vs. Black; White vs. Asian; White vs. Hispanic). χ^2 tests for categorical variables, and Student t test for continuous variables were used to compare the racial groups and adjusted linear regression analysis was used to determine the association between race and outcomes of interest. Significance was defined by a P-value less than or equal to 0.05.

RESULTS: We identified 18,015 patients who had an ICD-9 diagnosis of hip fracture and underwent surgical intervention (16,765 White, 686 Black, 469 Asian, 95 Hispanic). Black race was associated with a 1.62 times likelihood of delay to surgery (OR 1.62; 1.28-2.05), 0.77 times likelihood of CMS-reportable complications (OR 0.77; 0.60-0.93) and 0.60 times likelihood of death (OR 0.60; 0.37-0.85). Black and Asian races were associated with longer hospital stays relative to the White population. Analysis of Hispanic race yielded non-significant findings.

CONCLUSION: Racial disparities exist in the management of and outcomes following hip fracture. Multivariate analysis of propensity matched cohorts revealed that more than one race was associated with increased likelihood of tracked outcomes. Additional factors outside of those queried may be at play and warrant further investigation.

A Dedicated Orthopedic Trauma Service Has a Decreased Length of Stay and Decreased Number of Operative Procedures

Abstract ID: Paper 097

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BACKGROUND: A dedicated orthopedic trauma service has many benefits including a specialty-trained staff, dedicated operating room time, and dedicated tertiary staff. The goal of the study is to compare the efficiency of having a dedicated orthopedic trauma service by comparing dedicated orthopedic trauma staff vs. non-dedicated in quantifiable metrics including number of operative procedures, time to the OR, and length of stay for patients. In the current environment of medicine, the ability to streamline patient care has become very important, and the need to justify the resources necessary for a dedicated staff gains more importance.

METHODS: A retrospective review of the UAMS trauma database from 2014-2015 including all patients that required a trauma activation with orthopedic injuries and underwent an orthopedic surgery were included. All patients were separated using ICD-9 codes for injuries. The number of times to the OR for orthopedic-related problems, time to the OR, and total length of stay were reviewed.

RESULTS: Statistical significance was reached in patients presenting with forearm fractures and lower leg shaft fractures. Patients that were initially operated on by non-trauma staff did have a faster time to the OR (forearm 5.8 vs. 10.3 hours and lower leg 4.3 vs. 8.2 hours).

Total length of stay was found to be less in the trauma group vs. non-dedicated group (forearm 8.7 vs. 13.5 days and lower leg 12.9 vs. 18.5 days). Total number times to the OR for all orthopedic-related problems were less in the dedicated trauma staff vs. non-dedicated trauma staff (2 vs. 3 procedures). All values reached statistical significance set as $p < 0.05$. There were no significant differences in medical comorbidities between the groups.

CONCLUSION: A dedicated trauma-trained orthopedic staff allows for less trips to the OR for patients presenting with trauma activations with orthopedic-related injuries. A trained orthopedic staff also showed lower length of stay for patients presenting with forearm fractures and lower leg shaft fractures of approximately 5 days. Non-dedicated orthopedic staff did have faster times to the OR, but further analysis of the data showed more utilization of OR later in the day or at night. This study quantifies the benefits of having dedicated trauma trained orthopedic staff and an orthopedic trauma service.

The Operative Treatment of Scapula Fractures: An Analysis of 10,097 Patients

Abstract ID: Paper 098

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INTRODUCTION: The indications for operative treatment of scapula fractures have been increasingly debated over the past decade. More recently, the operative treatment intra-articular glenoid fractures has shown good functional outcomes with operative fixation. Our purpose was to (1) determine the incidence and trends in the operative treatment of scapula fractures, (2) determine the incidence of conversion from operative fixation to total or hemi-shoulder arthroplasty (THSA), and (3) determine rates of associated injuries in scapula fractures.

METHODS: The Humana Inc. administrative claims database was queried from 2008 to the second quarter of 2015. Patients with any scapular fracture, scapula ORIF, THSA, and associated injuries were identified by ICD-9 and CPT codes. Analysis was then performed for (1) all patients with operative management for scapula fracture, (2) all scapular fractures treated with ORIF or THSA, (3) all scapular fractures treated with ORIF with subsequent conversion to THSA on the same side, and (4) all scapula fractures with diagnosis of an associated injury (by ICD-9 diagnosis codes). The rates of THSA were compared between patients with any scapula fracture and patients with ORIF of scapula fractures using standard statistical techniques.

RESULTS: There were 10,097 scapula fractures (28.4% glenoid, 48% female). Documented scapular fractures doubled from 2008-2016. 60% occurred in patients 65 years and older. 198 scapula fractures (70% glenoid) were treated with ORIF (incidence=1.96%). 287 scapula fractures (45% glenoid) were treated with THSA (76% Total shoulder) with an incidence of 2.84%. The rate of ORIF of scapular fractures did not significantly increase in 2015 compared to 2007 (12 and 32 respectively, RR=0.87, p=0.58). There was a significant increase in THSA in 2015 compared to 2007 (76 and 12 respectively, RR=0.43, p=0.0016). Conversion from ORIF to THSA was 12.6%. Scapula fractures treated with ORIF were at significant risk for conversion to THSA (RR=4.77, p<0.0001). Total procedures (ORIF and THSA) increased significantly from 2007-2015 (RR0.57, p=0.0025). Associated injuries occurred in ~50% of scapula fractures—other fractures, lung contusion and pneumothorax/hemothorax ranking the highest (37%, 14.5%, and 8.3% of all associated injuries respectively).

CONCLUSIONS: Scapular fractures previously treated with ORIF were at increased risk for conversion to THSA. Although ORIF in scapular fractures did not significantly increase over time, both THSA and all (ORIF+THSA) operative treatment of scapula fractures increased significantly—indicating an increase in the operative treatment of scapula fractures in 2015 compared to 2007.

Clavicle Fixation in Adult Polytrauma Patients

Abstract ID: Paper 099

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INTRODUCTION: The literature regarding the optimal treatment of clavicle fractures has generally focused on isolated, mid-shaft injuries, giving little guidance on the multiply-injured patient. We sought to identify the injury patterns, factors that lead to open reduction and internal fixation (ORIF), and union rates for clavicle fractures in poly-trauma patients. We hypothesized that more severely injured patients, and those with concomitant lower extremity injuries would undergo operative treatment more frequently to help with mobilization.

METHODS: Polytrauma patients with Injury Severity Score (ISS) greater than 5 and a clavicle fracture who presented to a single level 1 trauma center over 7 year period (January 1, 2007, to December 31, 2013) were reviewed. 730 patients (739 clavicles) were included in the analysis. Data were collected about demographics, trauma mechanism, concomitant injuries, fracture patterns and OTA classification, and treatment. The Wilcoxon ranked sum and chi-squared test with Bonferroni corrections were used to identify significant factors related to treatment decisions

RESULTS: A total of 138 clavicles (18.7%) initially received operative treatment. Of the remaining 601 fractures treated initially non-operatively, 75 (12.5%) underwent eventual ORIF. Overall, 213 (28.8%) of the clavicles were treated with surgical fixation, which compare to rates in the literature ranging from 5-17%. There were no significant differences between the operative and non-operative groups regarding gender, ethnicity, comorbidities, mechanism of injury, presenting ISS or Glasgow Coma Scale (GCS), intensive care and total hospital stays, concomitant lower extremity, spine, head, chest or abdominal visceral injuries. Patients treated with ORIF were significantly younger than those treated conservatively (average age 41 for ORIF vs. 49 years old, $P<0.0001$). The presence of simultaneous scapula fractures (17 % vs. 10%), significant fracture displacement (average displacement 79% vs. 45%), and displaced, comminuted midshaft fractures (49% of Type 15-B3 underwent ORIF) were all associated with more frequent operative treatment (all $P<0.0001$). Of the 213 clavicles that ultimately underwent operative treatment, 31 (14.6%) required at least one subsequent operation, most commonly for implant removal.

CONCLUSIONS: Clavicle fractures in polytrauma patients undergo operative fixation more frequently than rates reported for isolated injuries. Increased ISS and concomitant lower extremity fractures do not lead to increased operative clavicle fracture fixation in polytrauma patients. Those selected for ORIF tend to be younger, with displaced mid-shaft fractures and simultaneous scapula fractures. Clavicle ORIF carries a significant risk of reoperations. Further research may help identify patients likely to fail non-operative treatment.

Is Early Operative Treatment of Displaced Midshaft Clavicle Fractures Worth It? Using Decision Analytics to Find the Most Cost-Effective Strategy Between Operative and Nonoperative Treatment

Abstract ID: Paper 100

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BACKGROUND: Treatment of displaced midshaft clavicle fractures remains a contentious subject. While previous studies have shown higher union rates and quicker return to work with operative treatment, there is disagreement over whether operative treatment results in improved clinical outcomes. Patients undergoing operative treatment sometimes require additional surgery for implant removal. Nonoperative treatment may fail treatment and ultimately require delayed surgical intervention. The duration of superior clinical benefits with operative treatment compared to nonoperative treatment has not been well established in the literature. Considering these uncertainties, surgeons are faced with a difficult decision of whether operative treatment of midshaft clavicle fractures is cost-effective. The purpose of this study is to find the most cost-effective strategy considering these uncertain parameters by using decision-analysis techniques.

METHODS: An expected-value decision tree was built to estimate the quality-adjusted life years (QALY) and costs for operative and nonoperative treatment. Values for parameters in the decision model were derived from the literature. Medical costs were obtained from the Medicare database. A Markov model was used to calculate the QALY for the duration of life expectancy. The decision model analyzed the duration of superior clinical benefits with operative treatment compared to nonoperative for 5 years and a lifetime. Sensitivity analysis was performed to determine which parameters have the most influence on the cost-effective decision.

RESULTS: Operative treatment is more cost-effective than nonoperative treatment in 95% and 99% of the Monte Carlo Trials in the 5-year and lifetime analysis, respectively. The cost per QALY with operative management is less than \$18,000 and \$4,000 in the 5-year and lifetime analysis, respectively. This is below the willingness to pay threshold of \$50,000 per QALY. For operative treatment to remain cost-effective, clinical benefits of operative treatment must persist for at least 2 years.

CONCLUSIONS: Operative treatment is more cost-effective than nonoperative treatment for displaced midshaft clavicle fractures. Clinical benefits with operative management must persist for at least 2 years for operative treatment to remain cost-effective.

Subscapularis Peel for Open Reduction and Internal Fixation of Proximal Humerus Fractures with a Head Split

Abstract ID: Paper 101

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INTRODUCTION: Proximal humerus fractures involving an articular head split are complex injuries. Long-term survival and satisfaction of arthroplasty-type procedures in the young patient are poor, and surgeons have advocated for initial attempted osteosynthesis of head-splitting injuries in younger patients in order to preserve the native articular surface and bone stock.

Head splitting injuries are relatively rare, and reported results for of attempted open reduction and internal fixation (ORIF) in younger patients is limited to several small case series, and isolated case reports.

There is variation in the surgical approach for treating head-splitting injuries, and authors have described using a superior subacromial approach, an extended deltoid split, working partially or entirely through traumatic intervals in open fractures. Prior manuscripts utilizing a delto-pectoral approach with subscapularis peel have been limited to single case reports.

METHODS: We present a retrospective series of five patients with head-splitting proximal humerus fractures treated with a deltopectoral approach and subscapularis peel to allow for direct visualization during reduction and fixation of the articular components.

RESULTS: All 5 patients healed their head-splitting fractures. Follow-up was an average of 27 months (range 11-35 months). There were no cases of avascular necrosis. There were no implant failures. No patients experienced humeral head collapse and humeral head screw penetration. There were no infections. There were no failures of the subscapularis repair. No patients underwent additional surgical procedures.

DISCUSSION: The rarity of this injury has led to a variety of proposed surgical exposures to attempt to anatomically reconstruct the humeral head articular surface, but there is no consensus on the ideal approach. In our cohort, all of our patients have gone on to uneventful healing, without the need for further surgical intervention. Long-term follow-up is needed, but we expect good survival of the locking plate construct in this population.

CONCLUSION: In younger patients with a head-splitting proximal humerus fracture, a subscapularis peel technique can be safely used to improve visualization and ultimately, anatomic reduction of the articular reduction. In this small series, there does not appear to be an increased risk of avascular necrosis, subscapularis repair failure, or need for further surgical intervention with the subscapularis peel technique at minimum 11 month follow-up.

Complications Following Open Reduction Internal Fixation vs. Total Elbow Arthroplasty in the Treatment of Distal Humerus Fractures

Abstract ID: Paper 102

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BACKGROUND: Distal humerus fractures in the elderly can represent a challenge to treating surgeons. Total elbow arthroplasty (TEA) can be useful for treatment of complex fractures of the distal humerus; however, open reduction internal fixation (ORIF) still remains the gold standard. The purpose of this study was to compare the incidence of short-term complications following surgery and impact on hospital length of stay (LOS) and discharge destination following TEA versus ORIF for the treatment of distal humerus fractures.

METHODS: Data from the 2012-2015 American College of Surgeons National Surgical Quality Improvement Database (NSQIP) were queried for all patients with distal humerus fractures treated with either ORIF or TEA and at least 45 years of age. TEA patients were matched to ORIF patients based on propensity scores that were generated from patient-level demographics, comorbidities, ASA classification, functional status, and elective versus emergent procedure type. Multivariable logistic regression was used to determine the association between treatment choice (ORIF versus TEA) and odds of prolonged hospital LOS and discharge destination (home versus post-acute care facility). The incidence of 30-day postoperative complications (pulmonary embolism/deep venous thrombosis [PE/DVT], surgical site infection, wound dehiscence, readmission, and reoperation) was calculated for the entire, non-matched sample.

RESULTS: From 2012-2015, 595 patients were identified using the NSQIP database, aged 45 and older with a distal humerus fracture that underwent either ORIF (N = 525) or TEA (N = 70). Propensity score matching yielded identically-sized cohorts of ORIF (N = 70) and TEA (N = 70) patients that were balanced across all covariates other than elective surgery status. The incidence of postoperative complications all within 30-days was 5.7% in the TEA cohort and 7.6% in the ORIF cohort (p=0.8). Following propensity score matching, treatment choice was not associated with significantly different odds of prolonged LOS (odds ratio 1.66, 95% CI 0.61 – 4.5, p = 0.32) or discharge to home (OR 0.6, 95% CI 0.25 – 1.47). Prior to matching, increased BMI, ASA class, and hypertension were all associated with increased odds of experiencing a short-term complication regardless of treatment method.

CONCLUSIONS: Treatment choice in distal humerus fractures did not lead to a significant difference between hospital LOS or discharge destination. Regardless of fixation methods, patients with increased BMI, ASA class and hypertension are at higher risk for short-term complications. These results can help guide the discussion regarding prognosis with patients undergoing ORIF or TEA for distal humerus fractures.

Societal Costs in Displaced Transverse Olecranon Fractures: Using Decision Analysis Tools to Find the Most Cost-Effective Strategy Between Tension Band Wiring and Locked Plating

Abstract ID: Paper 103

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BACKGROUND: Tension band wiring (TBW) and locked plating are common treatment options for Mayo IIA olecranon fractures. Clinical trials have shown excellent functional outcomes with both techniques. Although TBW implants are significantly less expensive than a locked olecranon plate, TBW often requires an additional surgery for implant removal. To choose the most cost-effective treatment strategy, surgeons must understand how implant costs and return to the operating room influences the most cost-effective strategy. This is a cost-effective analysis study exploring the optimal treatment strategies by using decision-analysis tools.

METHODS: An expected-value decision tree was constructed to estimate costs based on the 2 implant choices. Values for critical parameters, such as implant removal rate, were obtained from the literature. A Monte Carlo simulation consisting of 100,000 trials was used to incorporate variability in medical costs and implant removal rate. Sensitivity analysis and strategy tables were used to show how different parameters influence the most cost-effective strategy.

RESULTS: TBW was the most cost-effective strategy with a cost savings of about \$1300. TBW was also the dominant strategy by being the most cost-effective solution in 63% of the Monte Carlo trials. Sensitivity analysis identified implant costs for plate fixation and surgical costs for implant removal as the most sensitive parameters influencing the cost-effective strategy. Strategy tables showed the most cost-effective solution as 2 parameters vary simultaneously.

CONCLUSION: TBW is the most cost-effective strategy in treating Mayo IIA olecranon fractures despite a higher rate of return to the operating room.

Blocking Screws Definitively Improve Alignment and Decrease Reoperation in Retrograde Nailing of Distal Femur Fractures

Abstract ID: Paper 104

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INTRODUCTION: Blocking screws (Poller screws) are a useful adjunct for the intramedullary nailing of distal femur fractures. However, there are no studies directly comparing outcomes between distal femoral fracture patients treated with and without blocking screws. The purpose of this study is to determine if significant differences in alignment and reoperation rate were observed for distal femur fractures treated with retrograde femoral nails with and without blocking screws.

MATERIALS AND METHODS: Over a six-year-period, utilizing CPT code 27506, we retrospectively identified 77 distal third femur fractures treated with a retrograde femoral nail. The patients were subsequently divided into groups who did [BLOCK] and did not [NO BLOCK] receive blocking screws. A sub-analysis of distal fourth fractures was also performed. Alignment between the main proximal and distal fragment was measured in the sagittal and coronal planes on post-operative lateral and anteroposterior (AP) radiographs of the distal fracture site using ImageJ (National Institutes of Health, Bethesda, Maryland). Similar to Krettek, overall malalignment was calculated as the sum of malalignment in the sagittal and coronal planes. The Electronic Medical Record (EMR) was queried for all reoperations, excluding those unrelated to alignment such as fasciotomy and staged debridement. Statistical analysis with two-tailed t-tests assuming unequal variances and chi-square analysis was used to compare the BLOCK and NO BLOCK groups for the distal third and sub-group distal fourth femur fracture patients.

RESULTS: There were 34 patients in the BLOCK group and 43 patients in the NO BLOCK group. In sub-analysis of distal fourth fractures, 23 were in the BLOCK group and 26 in the NO BLOCK group. For the distal third fractures, the overall mean malalignment was greater in the group without blocking screws (BLOCK: 3.1°; NO BLOCK: 5.1°; $P<0.05$) and similarly for the distal fourth subgroup (BLOCK: 3.3°; NO BLOCK: 6.0°; $P<0.05$). Additionally, for the distal fourth fractures, the incidence of malalignment greater than 5° in any plane was much lower with blocking screws (BLOCK: 4.3%; NO BLOCK: 30.8%; $P<0.05$). The incidence of reoperation was lower in the blocking screw group (BLOCK: 8.8%; NO BLOCK: 25.6%; $P<0.05$) of which the majority were painful hardware removal (BLOCK: 1; NO BLOCK: 8).

CONCLUSION: This retrospective cohort study of distal femur fractures treated with retrograde intramedullary nails supports the routine use of blocking screws to improve alignment and reduce the risk of reoperation, and the data is even more profound for distal fourth femur fractures.

Proximal Femur Fracture Complications: A Systematic Review and Meta-Analysis

Abstract ID: Paper 105

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INTRODUCTION: Nonunion after fixation of a proximal femur fracture is associated with increased disability, pain, and costs to the patient and healthcare system. Understanding the effect of fixation method and fracture pattern on healing is important to optimize patients' likelihood of healing. This study was performed to evaluate healing, nonunion, and reoperation rates after internal fixation of proximal femur fracture.

METHODS: We performed a systematic review and meta-analysis of all published records from PubMed, Embase, and the Cochrane Review system. Included studies had a sample size of greater than 20 consecutive adult patients with acute, non-pathologic proximal femur fractures after primary internal fixation. Excluded were studies on abnormal patient or fracture populations and unusual fixation techniques. We also excluded studies on arthroplasty, as fracture healing cannot be assessed in the setting of joint replacement.

RESULTS: We included 160 studies with 19,163 extracapsular proximal femur fractures and 55 studies with 6,029 intracapsular proximal femur fractures. Intracapsular fractures had a lower healing rate, higher total reoperation rate and higher nonunion rate than extracapsular fractures ($p < 0.00001$).

Among intracapsular fractures, healing occurred in 79.7%, nonunion in 11.6%, and other unplanned reoperations in 8.6%. Neck-based fixation had a higher rate of nonunion (10.4%) than plate fixation (5.3%) in studies on both displaced and nondisplaced intracapsular fractures ($p < 0.00001$). Nonunion after neck-based fixation was even higher in studies on displaced intracapsular fractures only (neck-based fixation 17.8%, plate fixation 7.6; $p < 0.001$).

Among extracapsular fractures, there was no difference in healing, total reoperation, or nonunion rates between nail and plate fixation. However, plate fixation of extracapsular fractures had higher rates of reoperation for mechanical failure (0.9%) than nail fixation (0.4%; $p < 0.00001$), particularly among studies published in 2000-2015 on unstable extracapsular fractures (plates 2.2%, nails 0.5%).

DISCUSSION AND CONCLUSION: Choice of fixation method for high-risk fractures is critical to avoiding nonunion and improving reoperation rates. Plate fixation of displaced intracapsular fractures had lower nonunion rates than neck-based fixation. Nail fixation of unstable extracapsular fractures had lower rates of reoperation for mechanical failure than plate fixation.

Use of Inherent Anteversion of an Intramedullary Nail to Avoid Malrotation in Comminuted Femur Fractures: A Prospective Study

Abstract ID: Paper 106

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INTRODUCTION: Rotational malalignment after locked intramedullary (IM) nailing of femoral shaft fractures ranges from 19% to 56%. Differences greater than 15° lead to functional complaints. Several techniques have been suggested to avoid this problem especially in transverse or comminuted femoral shaft fractures. Espinoza et al have described a technique using the inherent anteversion of an intramedullary nail to avoid malrotation in femur fractures (Espinoza Technique or ET). The purposes of this study are to (1) evaluate this technique in preventing malrotation after locked IM nailing of comminuted femoral shaft fractures, (2) evaluate our accuracy of centering the proximal locking screw in the femoral head, and (3) assess the variation of anteversion due to the inherent play in the nail itself.

METHODS: A prospective IRB approved study included 43 consecutive patients with comminuted femur fractures of who 19 patients were treated by the ET and 23 by our normal fluoroscopic assessment to achieve the correct femoral version. All patients had postoperative CT scanograms for length and rotation.

RESULTS: The ET produced an anteversion of 9.43° +/- 5.4° (range 1.91-16.53), the traditional method 6.87 +/- 11.0° (range -14.39 - 27.13) ($p < 0.0230$). A >15° difference from the native leg was observed in 8/23 traditional arm patients (34.8%, 95% CI 15.3, 54.2%) and 1/19 (5.26%, 95% CI 0, 15.3%) ET patients (95% CI 3.0, 9.3) ($p\text{-value} < 0.0268$). There was a 5° variability in our ability to center the proximal locking screw in the femoral head and 5° variation in distal locking.

CONCLUSION: The inherent anteversion of a second-generation nail can be used to minimize malrotation of the femur after comminuted fractures during locked IM nailing in patients with normal anteversion and is a very useful tool. However, there are patients with inherent anteversions outside the norm and it is difficult to account for these using the ET. Although no technique is perfect, this one seems to improve our accuracy, variability, and decrease the need for revision.

Cannulated Screw Fixation of Femoral Neck Fractures: Can an Extraosseous Screw Path Be Detected on Plain Radiographs?

Abstract ID: Paper 107

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INTRODUCTION: Cannulated screw fixation of femoral neck fractures is a common method of fixation of femoral neck fractures. A modified inverted triangle configuration places the posterosuperior screw in close proximity to the lateral epiphyseal artery if cortical perforation occurs. Additionally, intraoperative fluoroscopic evaluation of the posterosuperior femoral neck to ensure an intraosseous pathway of this screw is difficult. The purpose of this study was to determine if radiographic findings can be utilized to predict cortical perforation of the femoral neck during cannulated screw placement and to compare the clinical fate of hips with a confirmed extraosseous screw path to those without.

METHODS: All patients who underwent percutaneous cannulated screw fixation of a femoral neck fracture from 2005 through 2015 and had a postoperative CT (computed tomography) scan of the hip were identified. Postoperative anteroposterior (AP) and lateral radiographs were reviewed and the position of the posterosuperior screw relative to the cortex of the femoral neck was measured. Postoperative CT scans were reviewed to determine if any screw perforated the cortex of the femoral neck. Radiographic or CT signs of osteonecrosis (ON) of the femoral head were recorded, as was reoperation or conversion to hip arthroplasty (HA).

RESULTS: A total of 107 patients who underwent percutaneous screw fixation of a femoral neck fracture from 2005-2015 also had a CT of the pelvis available at a mean of 32 months postoperatively. Fifty-eight out of 107 (54%) of the patients had a clear extraosseous path of the posterosuperior screw on CT. Utilizing a threshold of < 15 mm as being diagnostic of a screw that was "in-out-in", the calculated sensitivity and specificity was of 86% (95% confidence interval: 74.62% to 93.85%) and 88% (95% confidence interval: 75.23% to 95.37%), respectively. The rate of ON was 5% and 2% in patients with and without an extraosseous screw, respectively (p-value > 0.1). The rate of conversion HA was 4% and 2% in patients with and without an extraosseous screw, respectively (p-value > 0.1).

DISCUSSION AND CONCLUSION: This study reveals an alarming high rate of cortical perforation of the posterosuperior screw. Implants less than 15 mm from the cortex on the AP and lateral radiograph combined may be at risk for perforation. The clinical consequences of femoral neck perforation remain unknown, as the rates of conversion HA and ON in this study were low and did not allow statistical correlation with cortical perforation of the posterosuperior femoral neck.

MAOA BREAKOUT SESSION #9
TOTAL KNEE ARTHROPLASTY
April 20, 2018

The Impact of an Acute, Traumatic Wound Dehiscence on Clinical Outcomes Following Primary and Revision Knee Arthroplasty

Abstract ID: Paper 108

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INTRODUCTION: Outcomes following a traumatic wound dehiscence in the early postoperative period have not been investigated. The purpose of this study was to determine the outcomes of an acute traumatic wound dehiscence following knee arthroplasty treated with an urgent irrigation and debridement and primary wound closure.

METHODS: Using a single institution's arthroplasty registry, we identified patients sustaining an acute, traumatic wound dehiscence following primary and revision total knee arthroplasty. Patients experiencing chronic wound drainage without injury or a history of prior knee infection were excluded. Patients were followed for the occurrence of complications including periprosthetic joint infection (PJI) and clinical outcomes using the Knee Society Score (KSS).

RESULTS: From 2006 to 2016, 17 of 25,819 patients (0.07%) were identified as having a traumatic wound dehiscence (15 after a fall; 2 at maximum flexion). The mean time from knee arthroplasty to wound dehiscence was 13.5 days (range, 0 to 51 days). All but one patient was treated operatively within 24 hours of dehiscence. Postoperative antibiotics were administered for a mean of 21 days (range, 1 to 150 days). At a mean of 5.7 years (range, 0 to 12), 6 patients were considered failures (35%) including two deep infections (one requiring a second I+D and one a two-stage exchange), two revisions for instability, and two patients who had a KSS < 60 points and were considered clinical failures. The mean KSS was 92 points (range, 80 to 100) among the remaining patients.

CONCLUSION: Despite emergent I&D and wound closure, patients experiencing an acute traumatic wound dehiscence following knee arthroplasty subsequently exhibit high rates of reoperation, periprosthetic infection, and clinical failure. Further work is required to better understand the optimal modes of treatment for this complication and to mitigate the risk of falls in the early postoperative period that can lead to wound dehiscence.

HEPA Filters Do Not Affect Infection Rates Following Primary Total Joint Arthroplasty with Forced-Air Warmers

Abstract ID: Paper 109

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BACKGROUND: Forced-air warmers (FAW) have been alleged to pose an infection risk during surgery. To address this, a new generation of FAW with high efficiency particulate air filters (FAW-HEPA) were introduced. This study compared infection rates following total joint arthroplasty (TJA) procedures using FAW and FAW-HEPA.

METHODS: Patients who underwent primary TJA at a single institution were retrospectively reviewed. In 2014, the institution switched from FAW to FAW-HEPA. A total of 5,405 TJA cases in 2013 and 2015 were identified. In 2013 (n=2,792) procedures used FAW, while in 2015 (n=2,613) procedures used FAW-HEPA. The primary measured outcome was the 90-day infection rate. Prosthetic joint infection (PJI) was defined as reoperation with arthrotomy or meeting MSIS criteria for PJI. Surgical site infection (SSI) was defined as a wound complication treated with antibiotics or irrigation and debridement. The χ^2 -test was used for univariate analysis, while logistic regression models were adjusted for age, gender, comorbidities, BMI, and operative time.

RESULTS: The groups had no differences in demographics or comorbidities, but operative time was significantly longer in the FAW-HEPA group (111 min vs. 108 min; $p=0.001$). The FAW group had a higher rate of SSI (n=33[1.18%] vs. n=22[0.84%]; $p=0.21$), but a lower rate of PJI (n=13[0.47%] vs. n=20[0.77%]; $p=0.15$). The regression model did not show FAW to significantly increase the risk of SSI (Odds Ratio [OR]=1.47; 95% Confidence Interval [CI] 0.83–2.58; $p=0.18$), PJI (OR=0.53; 95%CI 0.25–1.13; $p=0.09$), or total infection (OR=1.00; 95%CI 0.65–1.57; $p=0.97$).

DISCUSSION: No statistically significant differences in SSI and PJI were found between FAW and FAW-HEPA use during TJA. Although studies have suggested that FAW increase infection risk, this study found no clinical difference.

CONCLUSIONS: FAW devices are not correlated to a higher risk of infection during TJA when compared to devices with HEPA filters.

Revision Total Knee Arthroplasty: Risk Factors for Manipulation

Abstract ID: Paper 110

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INTRODUCTION: Although there are a number of studies concerning manipulation (MUA) following primary total knee arthroplasty, there is a paucity of literature concerning manipulation following revision total knee arthroplasty (rTKA). The purpose of this study was to determine the incidence, timing, and risk factors associated with MUA following rTKA.

METHODS: The Humana administrative claims database was reviewed from 2007 to 2015 for all patients who underwent rTKA. Only patients enrolled with the insurance provider for a minimum of 3 months prior and 6 months following rTKA were included in the analysis. Current Procedural Terminology (CPT) codes and laterality modifiers were used to identify patients who underwent ipsilateral MUA following rTKA. Timing to MUA was calculated monthly for 6 months after TKA. Possible risk factors analyzed included preoperative narcotic use (opioids prescribed 3 months prior to TKA), smoking status, diagnosis of anxiety and/or depression, diabetes (DM), obesity (BMI > 35 kg/m²), patient age (<50 vs. ≥ 50 years), and sex. Multivariate logistic regression was utilized to determine odds ratio (OR) with 95% confidence intervals (CI) for risk of MUA for each factor analyzed.

RESULTS: In total, 5,184 rTKAs were included in the study. Ninety-three patients underwent a MUA for postoperative stiffness for an overall incidence of 1.7%. Of these, 65 (70%) patients underwent their MUA in the first 3 months following rTKA while the remaining 28 (30%) patients underwent MUA between 4-6 months after surgery. Univariate analysis demonstrated that young patients (<50 years) had significantly higher odds after rTKA (6.3 [3.1 to 11.4], p<0.0001). Males and females showed no difference in odds of MUA (0.97 [CI:0.63 to 1.47], p=0.84). Patients with a diagnosis of obesity, diabetes, anxiety and/or depression, previous history of narcotic use or a history of smoking showed no increased risk of MUA following rTKA. Multivariate logistic regression analysis demonstrated younger age remained significantly predictive of higher odds of MUA after rTKA.

DISCUSSION: In this multicenter cohort study, the incidence of MUA following rTKA was 1.7% (significantly lower than the 2.7% following primary TKA). The majority (70%) was performed within 3 months of surgery. Patients <50 had 6 times the incidence of MUA. No other risk factors were identified. This data should help counsel and treat the high-risk patients.

Total Knee Arthroplasty in the Osteoporotic Tibia: A Biomechanical Evaluation of the Role of Stem Extensions and Cementing Techniques

Abstract ID: Paper 111

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INTRODUCTION: When total knee arthroplasty (TKA) is performed in the osteoporotic patient, poor functional outcomes and aseptic loosening increase, primarily due to compromised fixation of the prosthetic components. This may be addressed by adding stem extensions to the components; however, little data exists to support this practice. In this biomechanical study, we evaluate the impact of a stem extension on the stability of tibial fixation in the osteoporotic patient.

MATERIALS AND METHODS: A standard design of tibial tray was implanted in a modified replica of the male osteoporotic tibia previously validated for fixation testing studies. Twenty-four implantations were performed using 3 variations of implant and cementing (8 surrogate tibias per group): (1) primary implant (34 mm keel) with surface cementing only, (2) primary implant with full cementing, (3) same as #2 with addition of a 30 mm stem extension. Each construct was mounted in an MTS load frame and subjected to 500 cycles of multiaxial loading simulating walking. The 3D components of tray-tibia micromotion were measured at medial and lateral sites using digital image correlation (DIC) analysis.

RESULTS: Total interface motion of the primary implants was $25.9\mu\text{m} \pm 14.7\mu\text{m}$ with surface cementing and $10.6\mu\text{m} \pm 7.6\mu\text{m}$ with full cementing ($p=0.001$). In comparison, the 3D motion of the fully cemented primary implants with a stem extension was only $4.4\mu\text{m} \pm 3.9\mu\text{m}$. This is only 17% of the surface cemented case ($p<0.0001$) and 42% of the fully cemented components without a stem extension ($p<0.009$).

CONCLUSION: As tibial components displayed greater stability when fully cemented, we do not recommend cementing of only the proximal surface of the osteoporotic tibia. As we observed the least micromotion after addition of a stem extension to the primary implant, we believe that the use of a longer stem may provide an advantage in osteoporotic TKA.

SUMMARY: In osteoporotic total knee arthroplasty, we found that use of tibial implants with stem extensions as well as fully cementing the tibial component leads to less micromotion in a biomechanical model.

Can Patients with Arthrofibrosis Following Total Knee Arthroplasty Achieve Comparable Outcomes Following Manipulation Under Anesthesia?

Abstract ID: Paper 112

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INTRODUCTION: Manipulation under anesthesia (MUA) has been shown to be an effective in treating arthrofibrosis in the early postoperative period following TKA. Whether MUA can help patients achieve comparable motion to primary TKA without arthrofibrosis has yet to be addressed. The purpose of this study is to evaluate whether patients with arthrofibrosis had equivalent motion following MUA to a matched cohort of TKA patients who didn't require MUA.

METHODS: We retrospectively reviewed a consecutive series of 134 patients from 2009-2015 at a single institution who underwent a MUA following TKA. We compared pre- and postoperative range of motion, comorbidities, diagnosis, and incidence of prior knee surgery with a matched cohort of primary TKA patients who did not require MUA. All patients had a minimum of 1-year follow-up. A backward, stepwise multivariate logistic regression analysis was performed to identify independent risk factors for requiring MUA.

RESULTS: At a mean follow-up of 27.5 months, patients undergoing MUA had a mean improvement in flexion of 24 degrees, but had less final mean postoperative flexion (105 versus 115 degrees, $p < 0.001$) than the matched TKA cohort. Of the 134 MUA patients, 16 (11%) underwent subsequent intervention with 11 patients (8%) requiring arthroscopic LOA, 2 patients (1%) with repeat MUA, and 3 patients (2%) with a revision TKA. Independent risk factors include preoperative ROM less than 90 degrees (OR 2.417, $p = 0.030$), prior open knee surgery (OR 2.387, $p = 0.014$), and prior arthroscopic surgery (OR 1.865, $p = 0.046$). Obesity was protective against requiring MUA (OR 0.561, $p < 0.033$).

CONCLUSIONS: Patients undergoing MUA following TKA demonstrated large gains in motion, but had less final flexion than a matched cohort of non-arthrofibrotic TKA patients. Patients with preoperative ROM less than 90 degrees, and prior open or arthroscopic knee surgery should be counseled about their risk for stiffness following TKA.

Cost and Patient Outcomes Associated with Bilateral TKA Performed by Two-Surgeon Teams vs. Single-Surgeon Practice

Abstract ID: Paper 113

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INTRODUCTION: Bilateral total knee arthroplasty (TKA) can be performed under a single-anesthetic (SA) or staged under a two-anesthetic (TA) technique. Recently, our institution began to pilot a two-surgeon team SA approach for bilateral TKA. The purpose of this study was to analyze cost and patient outcomes in the first 90 days after surgery between the team SA, single-surgeon SA, and single-surgeon TA approaches for bilateral TKA.

METHODS: All primary TKA performed from 2007-2016 by the two surgeons for each of the 3 groups were identified: team SA (N=27 patients; 54 knees), single-surgeon SA (N=145 patients; 290 knees), single-surgeon TA (N=216 patients; 432 knees). TA TKA was performed within 365 days for inclusion. Mean patient age was 66 years; mean BMI was 33; there were 63% women. Costs were calculated by using standardized, inflation-adjusted costs for services/procedures billed during hospitalization in 2016 inflation-adjusted dollars.

RESULTS: There were no differences in cost between the two SA techniques; however, both were approximately 50% less expensive than the TA technique ($p<0.001$). Mean hospital cost (per TKA) for the episode(s) of care was as follows: team SA \$21,598, single-surgeon SA \$21,500, single-surgeon TA \$31,276. Median length of hospital stay for the episode(s) of care was as follows: team SA 3.5 days, single-surgeon SA 3.9 days, single-surgeon TA 6.0 days ($p<0.001$). Blood transfusions were least likely in the team SA group ($p<0.001$). Discharge to skilled nursing facilities was as follows: team SA 9 (33%), single-surgeon SA 77 (53%), and single-surgeon TA after the second operation 74 (34%) ($p<0.001$). There were 34 complications in the first 90-days (8.8%). The most common complications were stiffness requiring manipulation under anesthesia (N=13) and perioperative medical complications (N=9). Rate of first 90-day complications was 3.7% for team SA, 9.6% for single-surgeon SA, and 8.8% for single-surgeon TA ($p=0.615$). There were 6 reoperations, all for superficial wound infection or dehiscence; 4 occurred in the single-surgeon TA group, 2 in the single-surgeon SA group.

CONCLUSION: This pilot project suggests that team SA bilateral TKA can provide a cost-neutral option compared to single-surgeon SA bilateral TKA. We observed shorter hospitalization, less blood requirement, and less frequent disposition to skilled nursing facilities in the team SA group with a trend toward a lower short-term complication rate. This technique may expand the pool of eligible patients able to receive SA bilateral TKA; however, further evaluation of this process will be mandatory to substantiate these relationships.

Implementation of a Total Knee Arthroplasty Care Pathway at a High-Volume Health System: Effects on Length of Stay, Discharge Disposition, and 90-Day Complications

Abstract ID: Paper 114

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INTRODUCTION: Total Knee Arthroplasty (TKA) standardized care pathways have emerged as a method for improving care by providing consistent, evidence-based algorithms for the entire episode of care. Despite the theoretical promise of care pathways, currently there is a limited and inconsistent literature demonstrating tangible improvements in patient care. The authors hypothesized that the implementation of a care pathway, across the health system, would lead to decreased complications, decreased hospital length of stay (LOS), and an increased proportion of patients discharged to home.

METHODS: A multidisciplinary team at a high-volume health system developed an evidence-based care pathway protocol for TKA perioperative care. The protocol was implemented across the health system during 2014.

All patients receiving TKA at the health system in 2013 (pre-protocol), 2014 (implementation), and 2015 (post protocol) were included in the analysis. Patient characteristics, postoperative complications, length of stay (LOS), and discharge disposition were collected retrospectively using electronic medical records. Multivariable regression was used to assess the impact of the care pathway on 90 day postoperative complications, LOS, and discharge disposition.

RESULTS: 6760 patients were included in the study. After adjusting for the covariates, the care pathway post-protocol phase was not associated with a change in 90-day complications (OR 1.074, 95% CI [0.913, 1.264]). The post-protocol phase was associated with a decrease in LOS (-0.791 days, 95% CI [-0.865, -0.718]) and an increase in discharges to home (OR 3.574, 95% CI [3.115, 4.106]).

CONCLUSIONS: The TKA care pathway implementation was successful in reducing LOS and increasing discharges to home without significantly increasing complications.

Cost-Analysis and Complications Associated with Simultaneous vs. Staged Bilateral Total Knee Arthroplasty

Abstract ID: Paper 115

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PURPOSE: The superiority of simultaneous versus staged bilateral total knee arthroplasty (BTKA) has long been debated. Simultaneous BTKA (simBTKA) has been described as a safe and convenient procedure associated with higher patient satisfaction, faster recovery, and lower costs when compared to staged BTKA (staBTKA). Previous studies estimating the cost of these procedures using models and cost-utility analyses found simBTKA to be more cost-effective. The primary objective of this study was to compare actual hospital costs at a single institution, and secondarily, complication rates between simBTKA and staBTKA.

METHODS: A total joint arthroplasty database from a single hospital was utilized to identify all patients who underwent primary BTKA from 2013-2016, and divided into simultaneous or staged groups. StaBTKA patients were included if both procedures were done within one year by the same surgeon. The combined total hospital cost of both procedures was used for staBTKAs and inpatient rehabilitation (IPR) costs were added for all patients discharged to the IPR unit.

RESULTS: There were 222 simBTKA patients and 355 staBTKA patients. SimBTKA patients were younger (61 ± 8 vs. 66 ± 8 years, $p < 0.001$), had a lower BMI (31.4 ± 5.9 vs 33.8 ± 7.1 , $p < 0.001$), and were predominately male (48% vs. 38%, $p = 0.015$), compared with staBTKA patients. In the simBTKA group, most of the patients were discharged to IPR (81%) while a majority of staBTKA patients were discharged home (69% and 75% after first and second admission, respectively). There was no difference in total hospital cost for simBTKA as compared with staBTKA ($\$24,596 \pm 5,652$ vs. $\$24,915 \pm 5,756$, $p = 0.586$). Complications were more prevalent in the simBTKA group, including venous thromboembolism (5.4% vs 1.4%, $p = 0.006$) and blood transfusions (15.8% vs 6.2%, $p < 0.001$), but no difference in 90 day events (17% in simBTKA vs. 22% in staBTKA).

CONCLUSION: There were higher complication rates with no significant cost savings in actual hospital costs associated with simBTKA, when accounting for the cost of IPR, as compared with staBTKA. The total cost analysis of simultaneous versus staged BTKA, using actual cost data, merits further evaluation.

A Comparison of Relative Value Units in Primary vs. Revision Total Knee Arthroplasty: Which Provides the Better Bang for Your Buck?

Abstract ID: Paper 116

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INTRODUCTION: Relative value units (RVUs) are utilized to determine the effort required for providing a service (or procedure) to a patient, and ultimately for compensation. Therefore, services or procedures, which require more effort or work, are assigned higher RVUs, and should theoretically provide greater physician compensation. In total knee arthroplasty (TKA), revision cases are often technically more challenging, and tend to require much more operative time and aftercare when compared to primary cases. There is a question of whether RVU values account for these differences. Therefore, the purpose of this study was to compare the: (1) RVUs, (2) length-of-surgery, and (3) RVU per unit of time between primary and revision total knee arthroplasty using a national database.

METHODS: We utilized the American College of Surgeons, National Surgical Quality Improvement Program database from 2008 to 2015 to identify patients who underwent either a primary (CPT code 27447) or revision (CPT code 27487) TKA. There were 165,538 patients who underwent a primary and 8,099 who underwent a revision total knee arthroplasty. The mean RVUs, length of surgery (in minutes), and RVU per minute were calculated. T-tests were used to compare variables between primary and revision TKA. A p-value of less than 0.05 was used to determine statistical significance.

RESULTS: There was a significant difference in the mean RVUs between primary and revision total knee arthroplasty (22 vs. 27 RVUs, $p = 0.001$). There was a significant difference in the mean length of surgery between primary and revision total knee arthroplasty (95 vs. 150 minutes, $p = 0.001$). The mean RVU per minute was significantly higher in primary versus revision TKA (0.3 vs. 0.2 RVUs per minute, $p = 0.001$).

CONCLUSION: It appears that despite revision total knee arthroplasty being a longer, more technically challenging procedure, there is a significantly lower RVU per minute assigned for performance. Therefore, orthopedic surgeons are reimbursed at a higher rate per minute for primary cases compared to revision total knees. This information can be utilized by orthopedic surgeons to understand the dynamics of their time, compensation, and ultimately, their practice.

Furthermore, it can be argued that there needs to be a shift to increase the RVU per unit time for revision TKAs, as they are more time-consuming, technically-challenging procedures.

Low-Dose Aspirin Has Non-Inferior Chemoprophylactic Effect on Venous Thromboembolism After Total Knee Arthroplasty

Abstract ID: Paper 117

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INTRODUCTION: Aspirin has been established as an effective prophylactic agent after total knee arthroplasty (TKA). Low-dose aspirin is effectively utilized in the prevention of cerebrovascular and cardiovascular events. There is no consensus on the optimal prophylactic dose for prevention of venous thromboembolic events (VTEs) after TKA. The study aims to compare the effect of low-dose to high-dose aspirin in terms of VTE, bleeding and mortality after TKA.

METHODS: We retrospectively reviewed 9,545 medical records for primary TKA patients between September 2012 and December 2016 at a large healthcare system. We identified 5,666 patients who received enteric-coated aspirin twice daily after surgery for 4 to 6 weeks depending on surgeons' preference. A total of 1,327 patients received 81-mg and 4,339 patients received 325-mg aspirin. Complications collected within 90 days were: VTEs (deep venous thrombosis [DVT] and pulmonary embolism [PE]), bleeding (gastrointestinal and wound bleeding), and mortality. We used multivariate regression to evaluate the effect of aspirin dose. We adjusted for age, gender, BMI, Charlson Comorbidity Index (CCI) score, and hospital length of stay (LOS).

RESULTS: CCI and hospital LOS were significantly different between the groups. There was no statistical significant differences between the groups in terms of VTE ($p=0.10$), PE ($p=0.13$), bleeding ($p=0.76$), or mortality ($p=0.79$) after surgery. DVT was significantly lower in the low- vs. high-dose (0.53% vs. 1.41%, respectively. $p=0.01$).

Interestingly, low-dose vs. high-dose was associated with reduced risk of DVT in the regression model (OR=0.38, 95% CI [0.17-0.84], $p=0.006$). After adjusting for confounders, low-dose vs. high-dose was not associated with increased risk of VTEs ($p=0.10$), PE ($p=0.17$), bleeding ($p=0.79$), or mortality ($p=0.78$).

CONCLUSION: Low-dose aspirin was not inferior to high-dose aspirin for the prevention of venous thromboembolism after TKA. Low-dose aspirin can be considered a safe and effective agent in the prevention of VTE after TKA.

Patients at Risk: Preoperative Opioid Use Affects Opioid Prescribing, Refills, and Outcomes After Total Knee Arthroplasty

Abstract ID: Paper 118

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BACKGROUND: The purpose of this study was to evaluate the effect of preoperative opioid use on opioid prescriptions, refills, and clinical outcomes following total knee arthroplasty (TKA).

METHODS: A retrospective review identified 113 opioid naïve patients and 53 patients on preoperative opioids who underwent primary TKA with at least one year follow-up. Opioid refills, Knee Society Score (preoperative and follow-up), morphine equivalent dose (MED) prescribed, and persistent opioid use were compared between groups.

RESULTS: The average total MED prescribed at discharge was 1280 mg, ranging from 0 to 4640 mg. The average daily MED used prior to discharge was greater in the preoperative opioid group compared to the opioid naïve group (90 ± 75 mg versus 53 ± 42 mg; $p=0.001$), yet the preoperative opioid group was discharged on a smaller average daily MED (125 ± 59 mg versus 156 ± 63 mg; $p=0.003$) and a smaller total MED prescription (1116 ± 899 versus 1355 ± 605 ; $p=0.04$). The preoperative opioid group, compared to the opioid naïve group, required more refills (1.3 ± 1.6 versus 0.4 ± 0.6 ; $p=0.0001$), was more likely to remain on opioids (21 [50%] versus 5 [5%], $p=0.0001$), had lower postoperative KSS (85 ± 11 versus 91 ± 14 ; $p=0.01$), and needed more manipulations under anesthesia (4 [8%] versus 1 [1%], $p=0.03$). Preoperative tramadol users had the same risk of refills, persistent opioid use, reduced KSS scores, and MUA as those taking other opioids.

CONCLUSION: Preoperative opioid users were discharged with less opioids, required more refills, were more likely to remain on opioids, and required more manipulations under anesthesia than opioid naïve patients. These risks extended to preoperative tramadol users.

Mepivacaine vs. Bupivacaine Spinal Anesthesia for Rapid Recovery Total Knee Arthroplasty: A Randomized Controlled Trial

Abstract ID: Paper 119

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PURPOSE: As rapid rehabilitation knee arthroplasty becomes mainstream, perioperative protocols need to be developed that facilitate a safe early discharge. Spinal anesthesia is an increasingly popular option yet there has been a paucity of evidence as to which anesthetic is optimal in this setting. The purpose of this study was to compare spinal mepivacaine versus bupivacaine in patients undergoing primary total knee arthroplasty in order to establish the efficacy, safety, and recovery profiles of spinal mepivacaine for rapid rehab arthroplasty surgery.

METHODS: The Consolidated Standard of Reporting Trials (CONSORT) statement was followed to conduct this prospective, double blinded, randomized controlled trial. Study design for IRB approval involved power analysis to detect a 30-minute difference in return of function. After informed consent, 32 consecutive adults undergoing unilateral primary total knee arthroplasty were enrolled based on the inclusion/exclusion criteria. Patients, surgeons, and assistants were blinded to the anesthetic. Primary outcome measures of motor and sensory recovery were assessed in 20-minute intervals on a standardized collection sheet. Secondary outcome measures included review of VAS pain scores, urinary function and opioid usage, distance walked with PT, time to discharge, and complications.

RESULTS: 31 patients were included in the study, 15 in the Mepivacaine group and 16 in the Bupivacaine group. Patient demographics were similar. The time to complete resolution of combined motor and sensory blockade was 55 minutes shorter in the mepivacaine group (M=168, B=223, $p=0.002$). Time to potential discharge readiness (after intentional urination, normal exam and pain controlled) was 71 minutes earlier in the mepivacaine group (M=345, B=416, $p=0.038$). There were significantly more patients at risk for catheterization in the bupivacaine group with failure to void within 6 hours (B=13/16, M=6/15, $p=0.029$). Pain was well controlled overall in both groups. While in the PACU there was a statistically but not clinically relevant difference in VAS scores (M=2.7, B=1.0, $p=0.046$). There was no difference in pain scores throughout the remainder of the admission. There was no significant difference in the rate of morphine consumption per hour at any point in the hospital admission. There were no episodes of TNS or blood transfusions in either group and no readmissions. Nausea was infrequent in either group with no difference in rescue medication.

CONCLUSIONS: Mepivacaine has a favorable duration of action for ambulatory knee arthroplasty with significantly faster return of neurologic function, time to discharge readiness, and bladder control compared to bupivacaine.

Have AAOS Knee Osteoarthritis Clinical Practice Guidelines Impacted Hyaluronic Acid and Corticosteroid Injection Use?

Abstract ID: Paper 120

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INTRODUCTION: Corticosteroid (CS) or hyaluronic acid (HA) injections have long been utilized for symptom management of knee osteoarthritis (KOA). However, a growing body of literature has begun to question the efficacy of these injections and also has shed light on high costs associated with these interventions. The purpose of this study was to determine the impact of AAOS clinical practice guidelines (CPG) on injection use and determine if utilization differed by provider specialty.

METHODS: The Humana administrative claims database was queried from 2007-2015 for all patients with KOA. The percentage of patients receiving a knee injection relative to the number of patients having an encounter for KOA were calculated and trended for the entire study period. The impact of each edition of AAOS CPG (1st edition: unable to recommend for or against HA injections, grade B recommendation for CS injection; 2nd edition: strong recommendation against HA injections, unable to recommend for or against CS injections) on HA and CS injection use were evaluated with segmented regression analysis. Injection trends were also evaluated relative to specialty of the provider performing the injection.

RESULTS: Of 1,065,175 patients with knee OA, 405,101 (38.0%) received at least one CS injection and 137,005 (12.9%) received a HA injection. The rate of HA injections decreased from 0.15 HA injections per 100 KOA patients per quarter year (inj/100 KOA/Q) to 0.07 HA inj/100 KOA/Q ($p=0.02$) after the 1st CPG and decreased at a rate of -0.12 HA inj/100 KOA/Q ($p<0.001$) after the 2nd CPG. CS injections increased at a rate of 0.13 CS/inj/100 KOA/Q from 2007-2015 ($p<0.001$). The use of HA injections by orthopedic surgeons and pain specialist decreased following the 2nd edition of CPGs, but did not change for primary care providers or non-operative musculoskeletal providers.

DISCUSSION: This study demonstrates that there have been subtle, but significant changes in the use of HA and CS injections in response to published CPGs. The subtle impact of the CPC publications on injection trends over time is of questionable clinical relevance given the small changes observed. Despite formal recommendations against HA injections and inconclusive recommendations for CS injections in the most recent CPG, these interventions remain in common use. Given the high costs of these injections and their questionable clinically efficacy, further interventions beyond publishing CPGs are needed to change practice patterns and improve value of care for KOA patients.

MAOA BREAKOUT SESSION #10
HIP PRESERVATION AND ARTHROSCOPY
April 20, 2018

Femoroacetabular Impingement (FAI) Syndrome and Pelvic Incidence: An Association of Spine Abnormalities and Hip Pathology

Abstract ID: Paper 121

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BACKGROUND: Spinopelvic radiographic parameters may significantly affect the incidence of hip and/or groin pain. Pelvic incidence (PI) is a position-independent radiographic parameter that quantifies the spinopelvic contribution to sagittal balance. In patients with PI abnormalities, hip pain may develop due to dynamic pelvic tilt compensation, in the setting of otherwise normal or minimally abnormal radiographic evaluation.

PURPOSE: To determine if pelvic incidence (PI) among patients presenting with FAI Syndrome is different from that of asymptomatic controls.

METHODS: Seventy-nine patients (mean age 38.2 \pm 13.9 years; 24M;55F) eligible patients with symptoms, clinical signs, and radiographic imaging consistent with a diagnosis of FAI Syndrome (per Warwick Agreement) were included. Patients with arthritis (joint space less than two millimeters or Tonnis grade greater than 0) and dysplasia (lateral center edge angle [CEA] or anterior CEA less than 20°, Tonnis angle greater than 15°, or femoral head extrusion index greater than 25%) were excluded (n=29). Radiographic evaluation consisted of a standing anteroposterior (AP) pelvis, false profile, Dunn 45°, and Dunn 90° lateral views. Each patient was classified as having cam-type deformity, pincer-type deformity, or a combined-type deformity. Cam morphology was defined via alpha angle greater than 50° on either Dunn or AP radiograph(s). Pincer morphology was defined via lateral CEA greater than 40°, posterior wall and ischial spine signs (global retroversion), crossover sign without prominent anterior inferior iliac spine (focal retroversion), or protrusio acetabulae. In addition, low dose biplanar fluoroscopic images (3-D EOS) were obtained from head-to-toe. Two independent investigators measured PI, sacral slope, and pelvic tilt. PI of the FAI Syndrome group was compared to a historical control group of 300 healthy asymptomatic volunteers, from a previously published study. Statistical comparisons were performed using t-tests. Interobserver agreement was calculated using Pearson's correlation.

RESULTS: Mean PI in all patients with FAI Syndrome (49.9° \pm 12.7° [range, 25°-83°]) was significantly less than asymptomatic controls (55.0° \pm 10.6° [range, 33°-82°]) (p<0.001). The subgroups for cam deformity, pincer deformity, combined deformity all had significantly lower PI than historical control (p=0.002, p=0.043, p=0.026, respectively). Interobserver agreement between reviewers was 0.83.

CONCLUSION: Patients FAI Syndrome had a significantly lower PI in comparison to asymptomatic controls. Patients with low PI may exhibit a “dynamic FAI” due to intentional anterior pelvic tilt in order to maintain sagittal balance.

Multi-Center Analysis of Prospectively Collected Outcomes of Hip Arthroscopic Labral Repair: Minimum Five-Year Follow-Up

Abstract ID: Paper 122

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PURPOSE: The technique of hip arthroscopy is advancing and becoming more commonly performed. However, most current reported results are limited to the short-term, and the durability of the procedure is largely unknown. The purpose of this study was to perform an analysis of mid-term outcomes of arthroscopic labral repair and determine risk factors for patient outcomes and subsequent surgery.

METHODS: Prospectively collected data from primary hip arthroscopic labral repair performed at four high-volume centers between 2008 and 2011 were reviewed. Patients were assessed pre- and postoperatively with visual analog pain scale (VAS), modified Harris Hip Score (mHHS), and Hip Outcome Score – Sports Specific Subscale (HOS-SSS) at a minimum of five years follow-up. Demographics were analyzed in relation to outcomes scores and their minimal clinically important difference (MCID). Failure rate, defined as subsequent ipsilateral hip surgery, was determined and analyzed using Cox proportional hazards.

RESULTS: 303 hip arthroscopies (101 male, 202 female) with a mean age of 32.0 years (range: 10.7- 58.9) were followed for a mean of 5.7 years (range 5.0 – 7.9). Patients achieved mean improvements in VAS of 3.5 points, mHHS of 20.1 points, and HOS-SSS of 29.3, surpassing the MCID for each score. Thirty-seven (12.2 %) patients underwent revision arthroscopy and 12 (4.0%) underwent periacetabular osteotomy, resurfacing, or THA during the study period. Patients with BMI > 30, age > 35, and Tonnis grade 2 preoperative radiographs demonstrated significantly lower mHHS and HOS-SSS scores, but no difference in VAS score as compared to patients with BMI ≤ 30, age ≤ 35, and Tonnis grade 0-1 radiographs, respectively ($p < 0.05$). In a multivariate model, BMI and preoperative Tonnis grade together best predicted mHHS and HOS-SSS at final follow-up.

CONCLUSIONS: Patients demonstrated significant, durable improvements in VAS, mHHS, and HOS-SSS at five years following arthroscopic labral repair. Subgroups with Tonnis grade 2 changes preoperatively, BMI > 30, and age > 35 demonstrated significantly decreased mHHS and HOS-SSS at final follow-up.

Outcomes of Hip Arthroscopy in the Medicare Population: Is There Value?

Abstract ID: Paper 123

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INTRODUCTION: Although the results of hip arthroscopy in the elderly have been inferior to the results in younger patients, there have recently been some encouraging reports in carefully selected series of older patients. The purpose of this study was to identify the utilization of hip arthroscopy in the Medicare population and to determine the rate and timing of revision arthroscopy and/or total hip arthroplasty (THA) with the goal of identifying risk factors for secondary procedures based on patient demographics, comorbidities, and the diagnosis at the time of arthroscopy.

METHODS: The Medicare Standard Analytic Files were reviewed from 2005-2014 for all patients undergoing hip arthroscopy allowing for minimum 2 year follow-up (100% sample). Patients were tracked through the dataset for the occurrence of an ipsilateral THA or revision hip arthroscopy. Rates and timing of the subsequent procedures were then determined within 6 month intervals. Patients less than 65 years old were excluded. Multivariate logistic regression analysis was performed to determine the impact of patient age, sex, obesity, or a diagnosis of hip osteoarthritis on need for revision procedures.

RESULTS: 3,320 Medicare patients had a hip arthroscopy during 2005-2014 (0.3% compared to THA). 73 patients (2.2%) underwent either a reoperation during the follow-up period. Two-thirds ($n = 46$) of all revision procedures occurred within one year of primary hip arthroscopy. A preoperative diagnosis of hip osteoarthritis significantly increased the odds of reoperation OR of 5.3.

CONCLUSION: Relatively few numbers of Medicare patients underwent hip arthroscopy during the time interval evaluated (0.3% when compared to THA utilization). 2.2% underwent a subsequent revision arthroscopy or THA with many occurring soon after the procedure and for the diagnosis of hip OA demonstrating the need to better define indications in this population. This study should provide baseline utilization and outcome trends for future studies.

Sexual Activity After Hip Arthroscopy – When and How?

Abstract ID: Paper 124

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BACKGROUND: Excessive hip motion with sexual activity following recent arthroscopic hip preservation surgery may compromise capsular and labral repair.

PURPOSE: To determine the safety of sexual activity after hip arthroscopy relative to hip instability and/or impingement risk.

METHODS: The 12 most common sexual positions were identified based on previous research. Gender-specific hip range of motion was then assessed for the possibility of post-arthroscopic instability (due to disrupted capsular repair) and/or impingement (labral or capsular compressive stress with disrupted repair) for all 12 positions (both right and left hips; leading to 15 different positions [male] and 14 different positions [female]). Instability risk was defined as hip extension greater than 0°, external rotation greater than 15°, or abduction greater than 20°. Impingement risk was defined as hip flexion greater than 90°, internal rotation greater than 0°, and adduction greater than 0°.

RESULTS: Return to sexual activity following hip arthroscopy may cause instability in 67% of males (10/15 positions) and 71% of females (10/14 positions). In male instability positions, 100% were unstable because of excessive external rotation, 20% due to excessive abduction, and 10% due to excessive extension. In female instability positions, 80% were unstable because of excessive abduction and 40% due to excessive external rotation. Return to sexual activity following hip arthroscopy may cause impingement in 33% of males (5/15 positions) and 53% of females (8/14 positions). In male impingement positions, 100% were due to excessive adduction. In female impingement positions, 63% were due to excessive flexion and 50% were due to excessive internal rotation.

CONCLUSIONS: Following hip arthroscopy, patients need to be made aware of the possibility of hip instability (over two-thirds of cases in males and females) and impingement (one-third of males and one-half of females) during sexual activity due to excessive hip motion that may compromise their outcome.

Impingement-Free Hip Range of Motion in Asymptomatic Young Adult Females

Abstract ID: Paper 125

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BACKGROUND: Femoroacetabular impingement is a recognized cause of early hip osteoarthritis. This is attributed to either a cam impingement caused by a non-spherical head or a pincer impingement caused by excessive acetabular coverage. Although many surgical techniques aim to improve hip range of motion, little normative data exist on dynamic impingement-free hip range of motion (ROM) in asymptomatic individuals. Hip ultrasound can effectively measure ROM by dynamically identifying labral anatomy and femoral morphology.

PURPOSE: The purpose of this study was to measure impingement-free hip ROM until labral deflection is observed and to measure the maximum degree of sagittal plane hip flexion when further flexion is limited by structural femoroacetabular abutment.

METHODS: Fifty-five asymptomatic adult female volunteers (110 hips) between the ages of 21 and 34 years underwent bilateral dynamic hip ultrasound examination. Femoral morphology was characterized and midsagittal flexion passive ROM was measured at two points: (1) at the initiation of labral deformation, and (2) at maximum flexion when the femur impinged on the acetabular rim. Additionally, AP pelvis x-ray was taken to correlate any pathological morphology. The mean age of the subjects was 26 ± 3 years and the mean body mass index was 23 ± 3 kg/m².

RESULTS: In asymptomatic females, mean impingement-free hip passive flexion measured from full extension to initial labral deflection was $72^\circ \pm 8^\circ$ (95% confidence interval [CI], 70–74). Mean maximum midsagittal passive flexion, measured at the time of bony impingement, was $101^\circ \pm 11^\circ$ (95% CI, 99–103). There was a statistically significant correlation between impingement-free hip flexion and maximum midsagittal flexion ($R = 0.665$, $p < 0.001$).

CONCLUSIONS: Using dynamic ultrasound, we found that passive ROM in the young asymptomatic female hip was approximately 100° , much less than the motion reported in the literature. Surgical procedures that treat femoroacetabular impingement should be evaluated based on these precise normative data.

Similar Outcomes Between Patients Managed with PAO Alone vs. PAO and Simultaneous Hip Arthroscopy for the Management of Developmental Dysplasia of the Hip

Abstract ID: Paper 126

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INTRODUCTION: Periacetabular osteotomy (PAO) remains the gold standard procedure for joint preservation in symptomatic developmental dysplasia of the hip (DDH). Intra-articular pathology often coexists with DDH and can be managed with hip arthroscopy (HA). However, there is limited data and no clear consensus whether addressing intraarticular disease with HA during PAO benefits DDH patients. This study aims to compare preoperative and 1-year postoperative clinical outcomes between 2 parallel patient cohorts managed with PAO alone versus PAO+HA.

METHODS: Data was prospectively collected from 2 surgeons at the same institution managing DDH patients with 2 parallel algorithms from September 2013-December 2015. One surgeon treated all patients with a PAO alone, but performed an arthrotomy to address any visible intra-articular pathology (N=40). The second surgeon treated all patients with PAO+HA, addressing intra-articular pathology identified during HA (N=62). There were 82% women, median age was 25 years, and mean BMI was 24.9. There was no difference in age, gender, or BMI between patients treated with PAO alone versus PAO+HA ($p=0.115$, $p=0.617$, $p=0.621$, respectively). Seventeen patients (17%) had a concomitant diagnosis of acetabular retroversion. Seventy-five patients (74%) had intra-articular intervention, either by HA or arthrotomy. Every patient filled out patient reported outcome (PRO) questionnaires at the preoperative and 1 year postoperative clinical visits including Harris Hip Score; all 5 subcomponents of the HOOS; all 4 subcomponents of the WOMAC; UCLA Activity Score, and both subcomponents of the SF-12.

RESULTS: Preoperatively, there were no significant differences in any of the 13 PROs between patients treated with PAO alone and PAO+HA. All PROs improved for the entire cohort postoperatively ($p<0.0001$). Patients treated with PAO alone experienced a greater mean increase in PRO scores from baseline compared to patients treated with PAO+HA in 10/13 PROs; however, no differences in any PRO were significant. Likewise, PRO scores for the entire cohort demonstrated no significant relationship with performance of intra-articular intervention, presence of acetabular retroversion, age, or BMI. Women demonstrated significantly greater mean improvement than men in all 13 PROs.

CONCLUSIONS: Treating patients with simultaneous PAO and HA was not beneficial in this cohort and in fact showed a trend toward slightly poorer outcomes. Women showed greater clinical improvement than men regardless of which treatment algorithm was applied. This work highlights the need for a high quality randomized clinical trial to provide definitive guidance on whether hip preservation surgeons should address intra-articular pathology at the time of PAO for DDH.

Medication Allergies Are Associated with Decreased Hip Function and Increased Pain Prior to and an Increased Revision Rate After Arthroscopic Hip Preservation Surgery

Abstract ID: Paper 127

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PURPOSE: To determine if there are statistically significant and clinically relevant differences in multiple preoperative patient-reported outcome (PRO) scores and revision surgery rates in patients with or without allergies undergoing hip arthroscopy.

METHODS: Consecutive subjects (n=308) undergoing hip arthroscopy with a one-year minimum follow-up were retrospectively reviewed. Patients were included if they completed preoperative Tegner, iHOT-12, HOS, and SF-12 scores. Allergies to medications were self-reported preoperatively. Patients were excluded if they did not complete preoperative scores or self-reported allergy questionnaire. The presence of a revision surgery (either before or after surgery by senior author) was recorded and analyzed. Clinical relevance was defined via minimal clinically important difference (MCID). Comparisons between patients with and without allergies were completed using Student's T test and chi-squared analyses.

RESULTS: Two hundred and twelve patients were analyzed (56% female, mean age 35.1+13.2 years). Seventy-two patients (34%) had allergies (range 1-10; 41 subjects had one allergy; 14 subjects had two; eight subjects had three; two subjects had four; seven subjects had five or more). Patients with one or more allergies had significantly worse preoperative Tegner Activity Level (p=0.0002), iHOT-12 (p=0.00001), HOS-ADL (p=0.013), HOS-Sports (p=0.024), and SF-12 PCS (p=0.002) compared to patients without allergies. There were clinically relevant differences between patients with one or more allergies compared to patients with no allergies for the Tegner Activity Level (1.6, MCID: 1), HOS-ADL (9.2, MCID: 9), and HOS-Sports (9.8, MCID: 6). There was a significant difference (p=0.001) in the revision rate based on number of allergies (0 allergies [5.7%]; 1 [9.8%]; 2 [7.1%]; 3 [38%]; 4 [0%]; 5+ [43%]).

CONCLUSIONS: In patients undergoing hip arthroscopy, the presence of one or more allergies was associated with statistically significant and clinically relevant lower preoperative patient-reported outcome scores and a higher revision rate.

Radiographic and Clinical Predictors of Pain and Impairment in Femoral Acetabular Impingement (FAI)

Abstract ID: Paper 128

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INTRODUCTION: It is hypothesized that morphological abnormalities in the femoral head or acetabulum lead to the development of femoral acetabular impingement (FAI), causing pain and impairment in young, active individuals. Radiographic and clinical predictors of pain in FAI are not well characterized. Our primary study aim was to investigate whether radiographically measured alpha angle correlates with baseline hip pain, function, and range of motion (ROM). We also examined other clinical factors such as gender and duration of symptoms which may predict symptom severity.

METHODS: Patients undergoing hip arthroscopy for FAI were electronically enrolled in a prospective cohort study between 2/2015 and 9/2016. Baseline patient-reported outcomes were collected including HOOS-Pain and HOOS-Physical Function Shortform (HOOS-PS). A chart review was performed to determine the alpha angle, duration of symptoms, passive ROM, as well as age and gender. Only those with a complete data set were included in the final analysis. Two-tailed student's t-tests and multiple linear regressions were performed to detect differences between groups, with significance set to $p=0.05$.

RESULTS: During the study period, 353 patients underwent arthroscopic hip surgery for FAI; 169 met final inclusion criteria. Of the 169 participants, 70% were female and the average age was 33.5 years old. The mean alpha angle for females and males were 58.25 ± 6.3 and 65.37 ± 7.5 degrees, respectively ($p < 0.0001$). The mean HOOS-pain score was 46.5 ± 16.7 and mean HOOS-PS score was 41.3 ± 17.3 . Gender and natural log of duration of symptoms were associated with HOOS-pain ($p=0.0006$ and $p=0.0486$, respectively), but not alpha angle in multiple linear regression analysis (model $p=0.008$, $R^2 = 0.1$). Gender was associated with HOOS-PS ($p=0.004$), but alpha angle and natural log of duration of symptoms were not in a multiple linear regression (model $p=0.02$, $R^2 = 0.06$). Lastly, we found that alpha angle was significantly greater in those with <15 degrees of internal rotation on passive ROM compared to those with >15 degrees ($p=0.02$).

CONCLUSIONS: In our study, there was a significant difference in alpha angle between males and females. However, we did not find that larger alpha angle, which describes greater morphologic abnormality, to be a strong predictor of hip pain. Patient factors including gender and symptom duration may be a more predictive of patient pain and function than radiographic or structural characteristics in patients who meet criteria for cam type FAI (alpha angle >50).

T2* Mapping Provides Information That is Statistically Comparable to an Arthroscopic Evaluation of Acetabular Cartilage

Abstract ID: Paper 129

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OBJECTIVES: The purpose of this study was to validate T2* mapping as an objective, non-invasive method for the prediction of acetabular cartilage damage.

METHODS: In a previous study, we established a quantitative predictive model for identifying and grading acetabular cartilage damage. In this study, the model was applied to a second cohort of 27 consecutive hips to validate this method.

A clinical 3.0-T imaging protocol with T2* mapping was used. Acetabular regions of interest were identified on MR and graded using our previously established model which included value thresholds for individual Beck grades of cartilage quality. Each ROI was then graded in a blinded fashion by arthroscopy. Accurate surgical location of ROIs was facilitated with a two-dimensional map projection of the acetabulum. A total of 459 regions of interest (ROI) were categorized by both MR and arthroscopy.

RESULTS: When T2* mapping and arthroscopic assessment were compared, 82% of regions of interest were within ± 1 Beck group (of a total 6 possible) and 32% of ROIs were classified identically. Disease prediction based on ROC analysis demonstrated a sensitivity of 0.713 and a specificity of 0.804. Model stability evaluation required no significant changes to the predictive model produced in the initial study.

CONCLUSIONS: These results validate that T2* mapping provides statistically comparable information regarding acetabular cartilage when compared to arthroscopy. In contrast to arthroscopy, T2* mapping is quantitative, non-invasive, and can be used in follow-up. Unlike research quantitative MR protocols, T2* takes little time and does not require a contrast agent. This may facilitate its use in the clinical sphere.

Mid- to Long-Term Osseous Remodeling After Femoral Head-Neck Junction Osteoplasty

Abstract ID: Paper 130

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OBJECTIVES: Osteochondroplasty has been associated with excellent clinical outcomes. Little is known about how the resection site remodels over long periods of time. Our objective was to describe the osseous remodeling of the femoral head-neck junction after osteochondroplasty at mid- to long-term follow-up (minimum of 5-years follow-up).

METHODS: A retrospective review of all patients that underwent osteochondroplasty between October 2004 and December 2006 at our institution was performed. All patients with a minimum 5-year frog-leg lateral radiographic follow-up were included. Head-neck offset (HNO), head-neck offset ratio (HNOR), and α -angle were measured on all frog-leg lateral radiographs preoperatively and postoperatively. The degree of cortical remodeling at the osteochondroplasty site was also graded as either none (no sclerotic margin at the resection site), partial (sclerosis was present but incomplete), or complete (a continuous cortical line was noted) on the frog-leg lateral radiograph. A paired sample t-test was used for all continuous variables. Longitudinal analyses for HNO, HNOR, and α -angle were carried out using repeated measures ANOVA. A p-value of 0.05 was considered significant.

RESULTS: Thirty-five hips, 19 left and 16 right, 20 females and 15 males, met inclusion criteria. Average age at the time of surgery was $27.9 \pm \text{SD} 9.51$ years (range, 14-48 years). Average radiographic follow-up was $8.1 \pm \text{SD} 2.1$ years (range, 5-12 years). Initial radiographic correction of cam-deformity was significant for HNO ($7.0 \text{ mm} \pm \text{SD} 2.5$ vs. $11.3 \text{ mm} \pm \text{SD} 2.5$, $p < .001$), HNOR ($0.12 \pm .04$ vs. $0.20 \pm .04$, $p < .001$), and α -angle ($53.2^\circ \pm 14.0$ vs. $38.9^\circ \pm 5.7$, $p < .001$). A small and gradual increase in HNO ($11.29 \text{ mm} \pm \text{SD} 2.50$ vs. $10.56 \text{ mm} \pm \text{SD} 7.16$), HNOR ($0.199 \pm .039$ vs. $0.195 \pm .138$) and α -angle ($38.92^\circ \pm 5.70$ vs. $39.36^\circ \pm 16.68$) was observed across longitudinal follow-up but was not statistically significant ($F=.257$, $p=.645$; $F=.048$, $p=.851$; and $F=0.52$ $p=.835$; respectively). Only two hips (5.7%) demonstrated increases in α -angle greater than 5° . One was osteophytic in a patient who subsequently underwent THA three months later and the other was asymptomatic. Recorticalization was present in 77% of hips (24 partial and 3 complete) at an average follow-up of 22.8 months. Recorticalization was present in 100% of hips (7 partial and 28 complete) at final follow-up.

CONCLUSION: There were insignificant postoperative changes in HNO, HNOR, and α angle over mid-to long-term follow-up after osteochondroplasty and the head-neck junction predictably remodeled to cortical bone at the resection site. This study provides us with additional confidence that an osteochondroplasty at the femoral head-neck junction is durable over long periods of time.

Are Results of Arthroscopic Labral and Capsular Repair Durable in Dysplasia at Mid-Term Follow-Up? A Prospective, Multi-Center Case-Control Study

Abstract ID: Paper 131

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PURPOSE: Hip arthroscopy is advancing and becoming commonly performed. However, most results are limited to the short-term, with largely unknown durability, especially in subpopulations such as hip dysplasia. The purpose of this study was to analyze patient reported outcomes (PROs) and surgical failure rates for arthroscopic labral repair in hip dysplasia as compared to demographically matched controls.

METHODS: Prospectively collected data for patients undergoing primary hip arthroscopic labral repair at four centers between 2008 and 2011 were reviewed. Patients with dysplasia, defined as lateral center edge angle (LCEA) < 25°, were matched by age, gender, BMI, and laterality to controls using a 1:2 nearest neighbor matching algorithm. Groups were compared using visual analog pain scale (VAS), modified Harris Hip Score (mHHS), and Hip Outcome Score – Sports Specific Subscale (HOS-SSS) at 5+ years follow-up. Kaplan-Meier modeling was performed for dysplasia and capsular repair subgroups.

RESULTS: 48 patients (21 males, 27 females) with dysplasia were matched to 96 patients without dysplasia (38 males, 58 females) by age, gender, and BMI. 52.1% of both groups underwent capsular repair. No difference was observed amongst dysplasia and capsular repair groups in terms of preoperative PROs, supporting postoperative comparisons.

Patients were followed for a mean of 5.7 years (Range: 5.0 – 7.9) and achieved improvements in VAS of 3.4, mHHS of 20.8, and HOS-SSS of 31.7 points ($p < 0.001$). Dysplasia and capsular repair did not demonstrate a significant effect on VAS ($p = 0.73$), mHHS ($p = 0.67$), or HOS-SSS ($p = 0.81$) at final follow-up. Dysplasia ($p = 0.94$) and capsular repair ($p = 0.21$), whether analyzed alone or in combination, did not predict subsequent ipsilateral hip surgery.

CONCLUSION: In a matched cohort of patients undergoing arthroscopic labral repair, dysplasia and capsular repair did not predict PROs or failure at five years' follow-up. These findings suggest that with careful selection and modern techniques, patients with dysplasia can durably benefit from arthroscopic labral repair, with comparable outcomes to demographically matched controls.

The Association Between Cam Deformity and Increased Joint Contact Stress Following Periacetabular Osteotomy

Abstract ID: Paper 132

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OBJECTIVES: Cam deformity is often present in patients with acetabular dysplasia, resulting in a combined dysplastic-impingement which adds significant complexity to surgical management of the dysplastic acetabulum. Computational modeling of joint contact stress can potentially identify deformities that adversely increase joint contact stress in dysplastic hips. Discrete element analysis (DEA) of cross-sectional computed tomography (CT) scans of dysplastic hips demonstrate variable changes in joint contact stress before and after periacetabular osteotomy (PAO). We hypothesize that cam deformity is associated with an increase in joint contact stress after PAO.

METHODS: Preoperative and postoperative CT scans from consecutive patients who underwent PAO were evaluated using DEA for change in joint contact stress. 20 patients with a postoperative increase in maximum contact stress were matched with 20 patients who demonstrated decreased joint contact stress. These 40 hips were assessed for femoral neck deformity on cross sectional imaging. Cam deformity was defined as an α angle $>50^\circ$ measured on reformatted axial CT scan images through the plane of the femoral neck, based on methods described by Notzli et al. Measurements were compared with the change in contact stress after PAO. Two-tailed student's t-tests and chi-squared tests were used to determine significance.

RESULTS: There was a significant difference in alpha angle for hips with increased joint contact stress ($M=51$, $SD=11.4$) versus decreased joint contact stress ($M=42$, $SD=5.1$); $t(38)=3.07$, $p=0.003$. Cam deformity was observed in 7/20 (35%) of hips with increased joint contact stress, compared with 1/20 (5%) of the hips with decreased stress. There was significantly higher odds of a cam deformity in hips with increased joint contact stress ($OR=10.23$, 95% CI, 1.12-93.34, $p=0.03$). Increased lateral center edge angle, decreased acetabular index, and correction of posterior wall sign when present were confirmed postoperatively, eliminating inadequate acetabular reorientation as a contributing factor to contact stress.

CONCLUSION: Proximal femoral deformity is a common finding in dysplasia patients. Alpha angles measured $>50^\circ$ were associated with increased postoperative joint contact stress after PAO for acetabular dysplasia. Hip preservation surgeons should assess the proximal femur for subtle deformity preoperatively with use of alpha angle measurement, and intraoperatively perform careful assessment of impingement during PAO.

A Standard Universal C-Arm Language: Assessing Its Need and Its Likelihood of Acceptance

Abstract ID: Paper 133

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INTRODUCTION: The use of intraoperative fluoroscopy has facilitated a dramatic change in surgical technique and patient outcomes over time. Poor communication between orthopedic surgeons and radiological technologists regarding use of intraoperative fluoroscopy (c-arm) leads to surgical delays, mutual frustration, and increased exposure to ionizing radiation. There is currently no standard terminology employed to facilitate intraoperative communication for c-arm use. The lack of a standardized language may lead to increased difficulty in communication between surgeon and technologists.

METHODS: The web-based survey was created consisting of both open-ended and multiple-choice questions to characterize c-arm use and communication in the operating room (OR) and to evaluate the willingness to adopt a proposed standard universal c-arm language. This survey was administered to orthopedic surgeons through the Canadian Orthopaedic Association, the American Academy of Orthopaedic Surgeons State List Servers, and Orthobullets.com. The same survey was administered to radiological technologists through The American Registry of Radiologic Technologists and the Canadian Association of Medical Radiation Technologists. Results were collected through surveymonkey.com and a descriptive analysis was run.

RESULTS: A total of 447 participants were surveyed, including 212 orthopedic surgeons (47%) and 235 radiological technicians (53%). Surgeon's experience included resident/fellow (36%), those in practice ≤ 15 years (33%), and ≥ 16 years (31%). Routine c-arm was reported as used by 97% and 89% of surgeons and technologists, respectively. Both groups also reported never having been taught a standard language for the use of c-arm (89% and 91% of surgeons and technologists, respectively) and reported having experienced confusion in the OR regarding c-arm use (92% and 96%, respectively). Of surgeons and technologists surveyed, 93% and 89% respectively reported exposure to unnecessary radiation due to confusion. Willingness to accept a standard universal c-arm language was reported for 83% of surgeons and 95% of technologists, respectively. Our proposed universal C-arm language would be either unequivocally accepted or accepted with only minor changes by 83% and 91% of surgeons and technologists, respectively.

DISCUSSION AND CONCLUSION: There is no standard universal c-arm language. Such a terminology would significantly decrease intraoperative confusion between orthopedic surgeons and radiological technologists. A vast majority of surgeons and technologists would accept a language similar to the one proposed. Future studies are needed to determine ease of implementation and clinical impact of a universal language in eliminating or reducing intraoperative confusion and unnecessary radiation.

MAOA BREAKOUT SESSION #11
HIP ARTHROPLASTY
April 21, 2018

A Novel Automated Text-Messaging Bot is Effective in Patients Undergoing Total Joint Arthroplasty: A Prospective Randomized Control Trial

Abstract ID: Paper 134

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INTRODUCTION: To optimize the delivery of healthcare information, there has been a recent surge in the development of mHealth apps. However, several drawbacks have surfaced. To date, existing engagement programs have shown low patient adoption rates. The purpose of this study is to evaluate the effectiveness of a novel automated text-messaging bot in patients undergoing primary total hip and knee arthroplasty (THA, TKA).

METHODS: A prospective RCT was designed based on an a-priori power analysis. The control group consisted of patients who underwent the traditional discharge teaching and follow-up, while the experimental group received automated text-messages in the 6-week postoperative period. The automated messages included recovery instruction, encouraging statements, videos from healthcare team, and instructional therapy videos. Patients were provided a calendar diary to record the daily home exercise minutes, VAS Mood Score, narcotic use as well as a final survey, assessing the clarity of instructions, perceived motivation, and overall satisfaction. Charts were reviewed to assess number of phone calls to the office, visits to an ED/urgent care, and validated patient reported outcomes at the postoperative appointments. Outcomes were compared between the groups using Student's t-test and Pearson's chi-squared test.

RESULTS: 80 patients have completed the 6-week postoperative course, 46 in the non-text group, 34 in the text group. Seven patients crossed over from the non-text group to the text-group on the first day after surgery. The patients in the text group exercised for 7.4 minutes more per day (44.8 +/- 17.7 vs 37.4 +/- 16.5 minutes; $p=0.008$) experienced an improved mood: 7.3 +/- 1.9 vs 6.4 +/- 1.7; $p=0.013$), and stopped taking narcotic medications on average of 10.1 days earlier (25.7 +/- 14.1 vs. 35.8 +/- 8.9 days; $p<0.001$). Significantly fewer phone calls were placed to office by the text group (0.9 +/- 1.0 vs. 3.0 +/- 4.3 calls; $p=0.011$). All patients receiving text messages strongly agreed that the instructions were clear (100% vs. 60%; RR 1.7, $p<0.001$), felt motivated (82.1% vs. 40%; RR 2.1, $p<0.001$) and encouraged (92.9% vs. 52.5%; RR 1.8, $p<0.001$).

CONCLUSION: An automated physician-specific text-messaging bot appears to increase

patient satisfaction scores, VAS mood score, minutes spent on home therapy exercises, decrease narcotic pain medication use, and calls to the surgeon's office.

Safety and Efficacy of Fast Track Prosthetic Joint Infection Care

Abstract ID: Paper 135

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BACKGROUND: Prosthetic joint infection (PJI) is associated with significant morbidity, mortality, and costs. After surgical intervention, patients often remain in the hospital up to 5 days for culture results and appropriate intravenous (IV) antibiotics. A Fast Track PJI care system was implemented utilizing an infectious disease physician to work specifically with the orthopedic surgery service and coordinate in the treatment of PJI patients. We hypothesize that Fast Track care of patients with hip and knee PJI decreases the length of the acute hospital stay without increasing the risk of complication or inappropriate administration of antibiotics (i.e., antibiotic mismatch).

METHODS: A single center retrospective chart review was performed using hospital billing codes to include 115 consecutive patients with 116 episodes of infection that were treated operatively for PJI. Using hospital length of stay (LOS) and cases of antibiotic mismatch as primary outcomes, a cohort of 48 Fast Track patients were compared to 68 patients treated prior to the implementation of the program. 90 day readmissions, reoperations, and mortality were compared. Log-rank and Pearson's tests were used to compare differences when appropriate.

RESULTS: Average hospital LOS from admission to discharge (6.62 vs. 4.85 days; $p=0.06$) as well as surgery to discharge (5.72 vs. 3.79 days; $p=0.03$) were lower in the Fast Track cohort in both cases with a statistically significant difference in the latter. There were no episodes of antibiotic mismatch in either cohort. No statistically significant differences were found comparing 90-day mortality, hospital readmissions, or reoperations within the study sample size.

CONCLUSION: With the institution of an orthopedic specific infectious disease physician, Fast Track PJI care effectively shortens hospital length of stay while remaining as safe as the old methodology. Further analysis of this new system of care will help optimize patient care and minimize the inpatient cost burden.

Can Bundled Payments Be Successful in the Medicaid Population for Primary Joint Arthroplasty?

Abstract ID: Paper 136

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BACKGROUND: While some bundled payment models have had success in total joint arthroplasty, concerns exist about access to care for higher cost patients who utilize more resources. The Affordable Care Act (ACA) also authorized new bundled payment demonstration projects for Medicaid patients in 2012; however, states have been reluctant to participate. The purpose of this study is to determine whether Medicaid patients have increased hospital costs and more resource utilization in a 90-day episode of care than Medicare or privately insured patients.

METHODS: We retrospectively reviewed a consecutive series of 7,268 primary hip and knee arthroplasty patients at a single institution. Using a propensity score 2:1 matching algorithm for demographic variables and comorbidities, we matched the 92 consecutive Medicaid patients with 184 privately insured and 184 Medicare patients. Hospital specific charges, costs, reimbursement, discharge disposition, complications, and 90-day readmissions were recorded. Outcomes for Medicaid, Medicare, and privately insured patient groups were compared using nonparametric hypothesis testing. Hospital costs were calculated from the institution's publicly available cost-to-charge ratios submitted to the Centers for Medicare and Medicaid Services. Multivariate logistic regression analysis was performed to identify independent risk factors for high-cost patients. Statistical significance was set at $p < 0.05$.

RESULTS: Medicaid patients had higher mean inpatient hospital costs than both of the matched Medicare and privately insured patient groups (\$15,396 vs. \$12,165 vs. \$13,864, $p < 0.001$) with longer length of stay (3.34 vs. 2.49 vs. 1.46 days, $p < 0.001$). Medicaid and Medicare patients were more likely to be discharged to a rehabilitation facility than privately insured patients (17% vs. 21% vs. 1%, $p < 0.001$). There was no difference in 90-day readmission rates (10% vs. 7% vs. 8%, $p = 0.723$) or in-hospital complication rates (3% vs. 3% vs. 4%, $p = 0.833$). When controlling for demographic factors and medical comorbidities, Medicaid insurance was a significant independent risk factor for increased hospital costs (OR 3.64, 95% CI 1.80-7.38, $p < 0.001$).

CONCLUSION: Because of increased hospital costs, current bundled payment models should not include Medicaid patients due to concerns about patient selection and access to care. Further study is needed to determine whether bundling Medicaid joint replacement costs in a stand-alone program with a separate target price will result in improved outcomes and decreased costs.

Metabolic Syndrome and Hip Fracture: Epidemiology and Perioperative Outcomes

Abstract ID: Paper 137

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PURPOSE: Metabolic syndrome is associated with increased morbidity following surgical procedures, yet little is known about the effects of metabolic syndrome in hip fracture patients. We sought to determine the prevalence of metabolic syndrome in hip fracture patients and to characterize its relationship with (1) in-hospital adverse events, (2) length of stay, (3) non-routine discharge, and (4) total charges.

METHODS: We identified 3,348,207 discharge records of patients with hip fractures during the years 2004-2013 using the Nationwide Inpatient Sample (NIS), and separated them into those with metabolic syndrome and those without metabolic syndrome. Metabolic syndrome was defined as having 3 or more of the comorbidities: obesity, hypertension, diabetes mellitus, and dyslipidemia. Multivariable logistic regression modeling was used to measure the association of metabolic syndrome with perioperative outcomes.

RESULTS: Of the 3,348,207 patients with hip fractures identified during the 10-year study period, 264,509 (7.9%) patients had metabolic syndrome. Patient demographics were similar between the two study groups. Metabolic syndrome patients were more likely to be insured by Medicare (84.3% vs. 81.9%) and be treated in an urban healthcare center (86.3% vs. 84%). The presence of metabolic syndrome was also found to be related to non-routine discharge (94.9% vs. 91.3%). Specifically, patients with metabolic syndrome were more likely to be discharged to a skilled nursing facility when compared to patients without (82.6% vs. 76.3%). The average total hospital charges were \$51,095 for those with metabolic syndrome and \$46,937 for patients without.

Metabolic syndrome was independently associated with several postoperative complications in hip fracture patients, including: acute renal failure (OR: 1.56, 95%CI=1.54-1.58, $P<0.001$), myocardial infarction (OR=1.23, 95%CI=1.20-1.27, $P<0.001$), and acute post-hemorrhagic anemia (OR=1.21, 95%CI=1.19-1.22, $P<0.001$) as well as higher total charges (OR=1.34, 95%CI=1.33-1.35). However, metabolic syndrome was independently associated with a reduced risk for postoperative pneumonia (OR=0.71, 95% CI=0.69-0.73, $P<0.001$), deep vein thrombosis and pulmonary embolism (OR=0.83, 95% CI=0.79-0.87), surgical site infection (OR=0.68, 95% CI=0.62-0.74, $P<0.001$), and septicemia (OR=0.67, 95% CI=0.65-0.70, $P<0.001$), along with decreased in-hospital mortality (OR=0.60, 95% CI=0.58-0.62) and shorter length of hospital stay (OR=0.93, 95% CI=0.92-0.94).

CONCLUSIONS: Metabolic syndrome is associated with increased resource utilization, expenses, and non-routine discharge. Metabolic syndrome does, however, demonstrate a protective effect on postoperative mortality. Aggressive perioperative management of all hip fracture patients, regardless of metabolic syndrome diagnosis, may decrease postoperative

complications. Greater awareness of metabolic syndrome and its health and financial consequences is important in the management of hip fracture patients.

Subspecialty Differences in Elderly Femoral Neck Fracture Management Based on Clinical Practice Guidelines

Abstract ID: Paper 138

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INTRODUCTION: The effect of AAOS Clinical Practice Guidelines (CPGs) for femoral neck fracture (FN fx) in the elderly on clinical practice is unknown. The purpose of this study was to survey Trauma and Arthroplasty Surgeons to investigate associations of specialty and treatment for displaced elderly FN Fx (e.g., fixation vs. arthroplasty, cementation use, surgical approach, anesthesia), and to compare them to CPG recommendations.

METHODS: 556 surgeons completed the online survey through either the trauma (OTA) or hip and knee (AAHKS) societies webpage. Respondents identified their subspecialty as arthroplasty (390, 70%), trauma (50, 9%), other (30, 5.5%), or none (80, 14.5%). An additional 6 respondents (1%) had undergone both trauma and arthroplasty fellowships. The survey consisted of two sections: surgeon demographic and practice information; and, two femoral neck fracture cases with affiliated questions regarding treatment and value weighted decisions. The first case simulated a 65-year-old active patient with Dorr B bone and a displaced subcapital femoral neck fracture while the second vignette portrayed a sedentary 75-year-old patient with multiple medical co-morbidities, a displaced femoral neck fracture and underlying Dorr C bone.

RESULTS: Trauma surgeons were less likely than Arthroplasty surgeons to recommend total hip arthroplasty (THA) and spinal anesthesia in both cases ($p \leq .01$). There were no differences between Trauma and Arthroplasty surgeons in cemented stem use, uni- or bipolar hemiarthroplasty (HHA) use, or approach ($p > .05$). Surgeons under age 40 were more likely to use cement ($p > .05$), regardless of subspecialty.

The majority of surgeons are familiar with CPGs and found them well-supported by literature, but only 21% made changes to their practice based on CPGs. The most common changes were "more use of cemented stems" and "expanded indications for THA." Justifications for treatment demonstrated a trend towards familiarity, training, and CPGs being the most important factors (>60/100) and cost, implant availability, and case duration being less important (<45/100).

CONCLUSION: Arthroplasty surgeons are more likely to recommend THA over HHA and request spinal/regional rather than general anesthesia for the treatment for displaced FN Fx in elderly patients. Overall, most surgeons are familiar with the CPGs and believe they are well supported by the literature, but few have changed their practice as a result.

Trends and Short-Term Complications of Three Common Methods of Fixation in Geriatric Femoral Neck Fractures

Abstract ID: Paper 139

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BACKGROUND: Hip fractures are among the most common injuries treated by orthopedic surgeons and are especially prevalent in the geriatric population. Surgical treatment options include total hip arthroplasty (THA), hemiarthroplasty (HA), and internal fixation. The purpose of our study was two-fold: (1) to analyze recent trends in the number of each surgery performed, and (2) to identify differences in short-term postoperative complications among the procedures.

METHODS: We performed a retrospective analysis of prospectively collected data using the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database on all patients over 65 years old who underwent surgical repair of a femoral neck fracture from 2006-2015. Trends in the frequency of THA, HA, and internal fixation (cannulated screws) were analyzed. Multivariate logistic regression was then used to control for patient variables and evaluate for associations in postoperative complications between THA and HA.

RESULTS: A total of 9,559 patients (69.7% female) with mean age of 79.7 (65-89) years were identified in this study. 7,789 (81.5%) underwent HA, 1,537 (16.1%) underwent THA, and 233 (2.4%) underwent internal fixation. Our results suggested a significant increase in the risk of readmission within 30 days in patients undergoing HA compared to THA (OR=2.66, p=0.0340), as well as an increased risk of acquiring pneumonia postoperatively (OR=1.58, p=0.0167). However, patients who underwent HA were less likely to require a reoperation (OR=0.73, p=0.0472) or blood transfusion postoperatively (OR=0.71, p<0.0001) compared to THA.

CONCLUSION: Hemiarthroplasty was the most commonly performed procedure for repair of geriatric hip fractures with an increasing trend of operations performed each year. Compared to total hip arthroplasty, hemiarthroplasty is associated with a higher risk of readmission and pneumonia but lower risk of reoperation.

Effect of Inpatient Mobilization on Mortality After Hip Fracture

Abstract ID: Paper 140

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BACKGROUND: Hip fracture in the elderly carries significant morbidity and mortality, with one year mortality rates ranging from 12-36%. Risk factors for increased mortality have been established and included high ASA score, chronic hemodialysis, and preoperative cognitive dysfunction. To our knowledge, no study has evaluated the relationship between the timing of postoperative mobilization and its influence on mortality. The purpose of this study was to determine the influence that postoperative physical therapy mobilization has on mortality following hemi-arthroplasty after hip fracture.

Our null hypothesis is failure to meet physical therapy benchmarks before discharge hospital discharge does not result in an increase in one-year mortality.

METHODS: We performed a retrospective analysis of a consecutive series of femoral neck fractures treated with a hemi-hip arthroplasty at a level 1 trauma center over 10 years. Data abstracted included: age, gender, mechanism of injury, comorbidities, treatment details, physical therapy progress, and discharge disposition. Outcomes assessed were mortality at 1-year and hospital readmission within 90 days. A multivariable Cox proportional-hazards model was used to examine predictors of mortality and readmission, and a Kaplan-Meier survival estimate was used to plot survival.

RESULTS: 137 patients were treated with hemi-hip arthroplasty and thus included in our analysis. 2 patients died in the hospital before consultation with physical therapy and excluded from the study. The final study population was 135 patients. Overall one-year mortality was 30%. 75 patients (55%) were able to walk before discharge, with an average time to walking of 3 days (1-20). 16 out of 75 patients that were able to walk before discharge were dead within one year compared with 24 out of 60 patients that did not walk before hospital discharge. (p value = .023). Using the Cox Proportional Hazards Model, and adjusting for age, comorbidities, ambulatory status and smoking status; patients walking before discharge had a 38% absolute risk reduction of one-year mortality (p value = .058). Walking before discharge also had a 40% absolute risk reduction of 90-day readmission, although not statistically significant (p value = .17).

CONCLUSIONS: In elderly people with a hip fracture treated with a hemi hip arthroplasty, ambulation with physical therapy, with or without assistance, appeared to reduce the risk of 1-year mortality by 38%. Interestingly, only 55% of these patients were actually able to walk before they were discharged to their next level of care, which is much lower than we anticipated. The null hypothesis can be rejected.

A Systematic Review of Total Hip Arthroplasty Outcomes in the Morbidly Obese Patient Population: Is a BMI Cut-Off of 40kg/m² Justified?

Abstract ID: Paper 141

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INTRODUCTION: The U.S. obesity epidemic has transcended into the elective arthroplasty population and surgeons must determine what extent of obesity is too great of a risk factor for poor outcomes in THA. Several studies have demonstrated a trend of worsening outcomes and complication rates with increasing levels of obesity, most notable in the super obese population (BMI \geq 50kg/m²); however there is less clear data available for the morbidly obese subgroup (BMI \geq 40 kg/m²). We hypothesize that morbidly obese patients have notably worse outcomes and complication rates than the non-obese population undergoing THA. We performed a systematic review of the literature to determine how morbid obesity impacts outcomes and complications in total hip arthroplasty.

METHODS: We used the preferred reporting items for systematic reviews and meta-analysis (PRISMA) guidelines. Using the search terms: “morbidly obese”, “obese” AND “total hip”, “obesity” AND “hip arthroplasty”, “THA”, “BMI”, and “body mass index”. Search terms were used in the Cochrane library database, Pubmed, Medline, and EBSCO from inception to 2017. Inclusion criteria required studies to define morbid obesity as a BMI \geq 40 kg/m² and have reported complication rates or clinical outcome scores. Independent data-analysis documented complication rates, outcome measures, age at time of surgery, pre- and postoperative functional outcome scores.

RESULTS: Initial screening identified 1379 articles that ultimately produced 10 articles meeting strict inclusion criteria for systematic review. These studies combined for a total of 15,691 primary elective THAs in morbidly obese patients. When compared to non-obese patients undergoing elective THA, the average timing of THA in the morbidly obese patient was 7.3 years earlier. 88% of studies showed increased complication rates in morbidly obese patients. Specifically, higher rates of infection, revision, 30-day readmission, DVT, and PE were noted in the morbidly obese population. Additionally, preoperative and postoperative outcome scores including WOMAC, HSS, and SF-12 were on average lower in the morbidly obese subgroup; however, the net improvement from preoperative functional outcome scores were similar in both groups.

DISCUSSION AND CONCLUSION: Although many surgeons have BMI cut-off reference ranges, data is lacking to justify more specific cut-off levels where BMI is clearly a demarcated risk. To our knowledge, this is the first systematic review of outcomes and complications specific to the morbidly obese THA patient. Although patients with BMI \geq 40 kg/m² may find equal net benefit in clinical outcomes, there is a clear increased risk for complications, and, thus, conservative measures with healthy weight loss should be proposed prior to proceeding with elective THA.

Uncemented Total Hip Arthroplasty Using Second-Generation Components: A Minimum 20-Year Follow-Up

Abstract ID: Paper 142

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INTRODUCTION: The purpose of this study was to evaluate the incidence of aseptic loosening and revision using a second-generation uncemented total hip arthroplasty followed for a minimum of 20 years. These results are compared to our previous published series using first-generation implants at 20-year follow-up.

METHODS: Between 1993 and 1994, 172 consecutive primary uncemented total hip arthroplasties were performed on 162 patients. In all cases, a Type I tapered femoral component with a reduced distal stem, a fully porous coated threaded hemispheric shell, and compression molded polyethylene (H-1900 resin) were used. The outcome of every hip in living and deceased patients was determined. Of the 102 patients (110 hips) who died prior to obtaining a minimum 20 year follow-up, one acetabular component had been revised. All femoral components remained in place at the time of the patient's death. In all 60 patients (62 hips) who survived a minimum of 20 years, detailed follow-up was obtained.

RESULTS: At a mean follow-up of 21 years, (20-24 years) six acetabular components (10%) had required revision, five for aseptic loosening, and one for sepsis. Two femoral components, (2%) had been revised, one for fracture and one for sepsis. Of those hips not requiring revision, only one acetabular was loose by radiographic criteria. All femoral components remained well fixed. Previously we published the results using a non-modular, Type I tapered femoral component articulating with a non-porous coated threaded ring cup. At 20 year follow-up, 12% of the femoral components and 57% of the acetabular components had been revised. The difference in the incidence of revision between the first and second generation components was statistically significant ($p \leq 0.01$).

CONCLUSION: In this series, the incidence of aseptic loosening and revision of both the acetabular and femoral components were low. These findings suggest that refinements in component design may be associated with excellent long-term fixation in cementless primary total hip arthroplasty.

Outcomes in Patients on Multiple Anticoagulants Undergoing Total Joint Arthroplasty

Abstract ID: Paper 143

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PURPOSE: Complications after total joint arthroplasty (TJA) are a multifactorial problem with potentially significant consequences to the patient, including morbidity and mortality as well as the associated financial cost to the healthcare system. Anticoagulants are used for a variety of indications and its use in this patient population is widespread. The purpose of this study was to determine the association between the use of multiple postoperative anticoagulants with postoperative outcomes in TJA.

METHODS: We performed a retrospective cohort analysis of 663 patients (388 TKAs, 275 THAs) with a history of TJA at a university affiliated tertiary medical center in Southeast Michigan from February 2014 to December 2015. All data were standardized and collected for inclusion in the Michigan Arthroplasty Registry Collaborative Quality Initiative (MARCQI). Information included patient demographics and a Charlson Index. After univariate two-group compilation, the study focused on multivariate comparison using significant associations through chi-square tests for categorical variables and a two-way analysis of variance with post-hoc Fisher's LSD tests for continuous variables. Patients on two or more anticoagulants postoperatively were compared to patients on one anticoagulant following surgery. The study employed an alpha of 0.05 for main effects, 0.10 for interactions, and 0.05 for post-hoc tests. All analyses used SAS 9.4 and SigmaPlot 12.3.

RESULTS: There were 205 patients that had two or more anticoagulants used following total joint arthroplasty (121 TKAs, 84 THAs) and 458 who did not (267 TKAs, 191 THAs). Overall, patients on more than two anticoagulants postoperatively were older (69.6 +/- 9.7 versus 64.3 +/- 10.6; $p < 0.001$), were more likely to have a length of stay above the median (3.7 days versus 2.9 days, OR 1.95 $p < 0.001$), and a higher rate of readmission (17.6% versus 9.0%, OR 1.92; $p < 0.01$). No statistically demonstrable differences were found between anticoagulant-use groups with regards to rate of deep vein thrombosis, pulmonary embolism, infection transfusion, 90-day postoperative events, ER visits or death.

CONCLUSION: This retrospective review identified the association of the use of multiple anticoagulants postoperatively with some negative clinical outcomes following total joint arthroplasty.

Acetabular Cup Position Measurements Are Not the Same with Intraoperative RadLink as Compared to Postoperative EOS: A Prospective Analysis

Abstract ID: Paper 144

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INTRODUCTION: Supine positioning used during direct anterior total hip arthroplasty (DA THA) facilitates the use of fluoroscopy and image analysis techniques, which are purported to improve acetabular component placement. We aim to assess the intraoperative accuracy of RadLink acetabular component position with postoperative EOS imaging analysis as control.

METHODS: We conducted a prospective analysis of 50 patients undergoing DA THA using RadLink intraoperative imaging system. Protocolled 6-week postoperative standing EOS biplanar images were obtained, deidentified, and sent to blinded EOS engineers, who performed all analysis.

Accuracy of RadLink measurements was determined using a Student's t-test, with EOS as control. Lasso regression multivariate method (SAS v6.1, Cary, NC) was used to assess for correlation with pelvic parameters.

RESULTS: The mean acetabular component anteversion and abduction as measured with RadLink was 17.9° and 43.0° (SD 4.4° and 3.2°), respectively. In the anatomic plane, the mean EOS measurement for anteversion and abduction was 20.6° and 42.6° (SD 6.7° and 3.3°). In the functional plane, the mean EOS measurement for anteversion and abduction was 21.2° and 42.7° (SD 5.9° and 3.3°). RadLink did not identify any acetabular components that were outside the Lewinnek safe zone (abduction 30°-50°, anteversion 5°-25°). EOS identified 12 anatomic and 10 functional plane measurements that were outliers; all of which were anteversion over 25°. RadLink measurements exhibited moderate correlation with EOS anatomic plane anteversion and abduction ($r=0.54$ and $r=0.59$), and EOS functional plane ($r=0.57$ and $r=0.57$).

Using a clinically acceptable threshold of $\pm 5^\circ$ of RadLink measurement error in the anatomic plane, 60% (RR=0.52) of anteversion and 92% of abduction RadLink measurements were inside the $\pm 5^\circ$ error tolerance. In the functional plane, 58% (RR=0.65) of anteversion and 92% of abduction RadLink measurements were inside $\pm 5^\circ$ error tolerance.

CONCLUSION: RadLink has a moderate correlation with EOS. Multivariate analysis shows the majority of error in anteversion is explained by pelvic parameters. However, only a minority of abduction error is due to pelvic parameters. The remaining source of error is inaccurate intraoperative image acquisition related to intensifier positioning and beam dispersion.

When a clinically acceptable measurement error threshold of $\pm 5^\circ$ was set for RadLink, 92% of abduction measurements, but only 60% of anteversion measurements were deemed accurate. Lastly, 12 acetabular cups (24%) guided by intraoperative RadLink analysis were found to be outside of the safe zone as determined by EOS.

Narcotic Usage Prior to Knee or Hip Replacement for Osteoarthritis

Abstract ID: Paper 145

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BACKGROUND: Narcotic use has been increasing in the United States with significant effects on health as well as health care cost. The use of narcotics has been found to be a modifiable risk factor for success of arthroplasty. We sought to determine how many of our patients reported narcotic use as a medication for osteoarthritis prior to primary knee or hip arthroplasty. We compared this to the amount of narcotic prescribed to the patient in our state database and attempted to determine factors involved in increased postoperative narcotic usage.

METHODS: A retrospective chart review was performed on new patients presenting to a busy orthopedic reconstructive-service clinic. New patients with osteoarthritis (OA) of the hip or knee over the age of 18 who presented over a one-year period were included. Chart review was performed to determine the reported narcotic use. The Arkansas prescription monitoring program website was then used to determine recent narcotic prescriptions filled. Benzodiazepine and the morphine milligram equivalents (MME) were also calculated both preoperatively and postoperatively for patients who underwent total hip or total knee arthroplasty (THA or TKA).

RESULTS: A total of 335 patients met the inclusion criteria. Of these patients, 108 (21.5%) reported recent narcotic use and 172 (34.3%) had been prescribed narcotics within the last 3 months ($P < 0.0001$, McNemar's Chi-squared test). A total of 191 patients underwent TKA or THA for OA. 73 of the 191 surgical patients were prescribed narcotics within 3 months of surgery. These patients required an average of 1437 MME in the 3 months postoperatively compared to 501 MME for patients who were not on narcotics preoperatively ($P < 0.0001$, t test). For patients who were prescribed benzodiazepines within 3 months of surgery ($N=13$), the average postoperative MME prescribed was 1816 compared to 789 MME for patients who were not on benzodiazepines preoperatively ($N=178$) ($P=0.0179$, t test).

CONCLUSION: This study suggests that patients under-report narcotic use when presenting with hip or knee osteoarthritis to an orthopedic surgeon. As narcotic usage is a risk factor for poor outcomes, surgeons should be aware of this and review each patient's prescriptions in their state database. We also found that that preoperative narcotic and benzodiazepine use are a predictor of increased postoperative narcotic use. A careful and astute plan needs to be utilized by the surgeon to counsel patients about reducing narcotic and benzodiazepine use prior to joint replacement surgery.

Recent Trends in Blood Utilization After Revision Hip and Knee Arthroplasty with Comparison to Primary Cases

Abstract ID: Paper 146

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INTRODUCTION: Evolving blood preservation strategies in primary total hip and knee arthroplasty including lowering trigger points for transfusion, specific hydration protocols, and use of antifibrinolytics have dramatically reduced blood transfusion requirements. There is a paucity of literatures concerning transfusion trends in revision total hip (rTHA) and knee (rTKA) since these strategies have been introduced. The purpose of this study was to evaluate current trends in transfusion following rTHA and rTKA, and compare the results to those following primary replacement.

METHODS: The Humana administrative claims database was reviewed from 2007-2015 for rTHA and rTKA. Blood transfusion following surgery was calculated and trended by year for the dates included. Rates were compared to primary procedures and analyzed to determine the effect of age, gender, geographic location, and obesity on transfusion requirements.

RESULTS: 9,176 rTHA and 12,493 rTKA procedures were analyzed. Transfusion rates decreased significantly from 24.7% to 10.3% after rTHA and 15.9% to 4.5% after rTKA over the follow-up interval. Women had higher transfusion rates after rTHA (OR 1.2) and rTKA (OR 1.4) while obesity was associated with lower rates after rTHA (OR 0.88). By 2015, there was no difference in rates for primary (4.4%) vs. rTKA (4.4%), but a difference (OR 0.83) for primary (8.7%) vs. rTHA (10.3%). One component revision rates were lower for rTHA and rTKA than primaries (OR 0.79 and 0.25, respectively).

CONCLUSION: Transfusion rates after rTHA and rTKA have fallen substantially since 2009 and are now 10% and 4% for rTHA and rTKA. Transfusions are comparable to primary procedures and are less than primaries when one component is revised. Future transfusion strategies should address the high risk groups (females and low weight).

Do Anteroposterior Radiographs Taken in the Lateral Position During Total Hip Arthroplasty Accurately Assess Cup Position?

Abstract ID: Paper 147

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INTRODUCTION: This study's purpose is to compare total hip arthroplasty (THA) acetabular component inclination and version on anteroposterior (AP) intraoperative radiographs taken in the lateral position with postoperative standing AP radiographs, and assess change in pelvic tilt as a risk factor for discrepancy in cup position.

METHODS: This was a retrospective radiographic review. Inclusion criteria: primary THAs performed using a posterolateral approach in the lateral position with AP intraoperative and postoperative standing radiographs of the pelvis. Exclusion criteria: revisions, complex primaries, and rotated radiographs (>5 degrees). Cup version and inclination were measured and compared between radiographs. Change in pelvic tilt was calculated using the obturator foramen height:width ratio (H:W) and assessed as a risk factor for discrepancy in cup position. Age, sex, and body mass index (BMI) were assessed as risk factors for discrepancy in cup position between radiographs.

RESULTS: 287 THAs were reviewed. 56% of intraoperative radiographs were rotated more than 5 degrees and excluded. 126 underwent full analysis. There were 77 females and 49 males. Average age was 63. Mean intraoperative version and postoperative version were 23.4 ± 6.5 and 24.5 ± 7.4 degrees, respectively ($P < 0.05$, effect size 0.2). Mean absolute difference in version was 4.3 ± 3.6 degrees (range -13 to +18). Version was within 5 and 10 degrees in 69 and 93% of radiographs, respectively. Mean intraoperative and postoperative inclination were 41.7 ± 6.9 and 44.6 ± 7.4 degrees, respectively ($P < 0.05$, effect size 0.4). Mean absolute difference in inclination was 4.6 degrees (range -14 to +19). Inclination was within 5 and 10 degrees in 65 and 92%, respectively. Mean change in sagittal pelvic rotation from lateral to standing was +9.4 degrees posterior tilt ($p < 0.05$). Increased posterior tilt directly correlated with increased anteversion and inclination on postoperative radiographs ($R = 0.43$ and 0.53 , respectively). There was no correlation between age, sex, or BMI and change in version or inclination between films.

CONCLUSION: 56% of intraoperative radiographs demonstrated > 5 degrees of axial rotation. Cup version and inclination on centered intraoperative and postoperative radiographs were within 5 degrees in 69 and 65% of cases, respectively. Differences in version and inclination >10 degrees were each observed in 8% of cases. Going from a lateral to standing position resulted in 9.4 degrees more posterior pelvic tilt. Assessing cup orientation on AP intraoperative radiographs taken in the lateral position should be done cautiously.

Blood Metal Levels and Leukocyte Profiles with a Modular Dual Mobility Hip Prosthesis

Abstract ID: Paper 148

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INTRODUCTION: Recently, a published series of a cobalt chrome modular liner for a dual mobility prosthesis raised concern over metal levels and potential adverse tissue response, presumably from ion release from the acetabular Co-Cr titanium modular interface. The purpose of this study was to evaluate the changes in blood metal ion levels and circulating subpopulations of monocytes and lymphocytes in a group of patients with a modular mobile bearing hip implant during clinical follow-up up to 2 years.

METHODS: IRB approval and informed patient consent were obtained prior to initiating the study. Forty-one (41) patients were enrolled in a retrospective cohort study with clinical follow-up up to 2 years. Blood concentration of chromium (Cr) and cobalt (Co) were measured. Flow cytometry was used to quantify the subpopulations of leukocytes, including CD14+ and, CD16+ monocytes, CD3+ T lymphocytes, CD19+ B lymphocytes, CD4+ Helper T-cells and CD45+RA memory vs naïve T-cells. Data were analysed using the SPSS software version 17.

RESULTS: The mean age for enrolled patients is 61.2 ± 11.9 years including 13 males and 28 females with a mean BMI of 30.8 ± 5.2 . The clinical performances of our patients with the implants are generally good, 5/41 (~12%) patients reported groin pain by the 2 years follow-up; they all have normal Co and Cr levels. Blood Cr levels were undetectable in all patients, while Co levels were only detectable in 4/41 patients (9.75%, range from 1-1.4 $\mu\text{g/L}$). The percentages of T cells, B cells, and subpopulations of T cells were relatively consistent. There was no increase of CD 16+ inflammatory monocytes.

DISCUSSION AND CONCLUSION: Owing to the recent introduction of modular dual mobility systems in hip arthroplasty, there are few reports describing its clinical performance. We found no issues when using these implants. The clinical results have been good and metal levels within acceptable ranges at 1-2 years. There is no evidence of activated immune response, as manifested by constant circulating leukocyte profiles and no increase of CD 16+ inflammatory monocytes.

Modifiable Risk Factors are Common in Early Revision Hip and Knee Replacement

Abstract ID: Paper 149

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INTRODUCTION: Obesity, smoking, uncontrolled diabetes, and poor dental health are modifiable risk factors for revision total joint arthroplasty. In an effort to protect patients from the devastating complication of revision surgery while also reducing cost, joint replacement surgeons apply strict contraindications for arthroplasty for patients with these conditions. However, adherence to this practice is variable among joint replacement surgeons. We hypothesize that a relatively high rate of revision arthroplasty patients had modifiable risk factors at the time of primary surgery.

METHODS: Using billing codes, a retrospective review was conducted of all revision total hip and knee arthroplasties performed at an academic, tertiary referral center within 2 years of primary surgery. The presence of BMI >40, A1c >8, poor dentition, and smoking status at initial presentation to our institution were obtained from the electronic medical record. Risk factors were described and compared between infected revisions and non-infected revisions using chi-square analysis.

RESULTS: 128 revision arthroplasties were performed at our institution from July 2015 to July 2016. 23/57 (40.4%) of total hip revision and 31/71 (43.7%) of total knee revision patients had at least one modifiable risk factor.

7/23 infected hip patients had increased BMI compared to 2/34 non-infected patients ($p=0.023$). 13/30 infected knee patients smoked compared to 5/41 non-infected patients ($p=0.005$). 10/30 (33.3%) of infected knee patients had poor dentition compared to 2/41 non-infected patients ($p=0.006$). 10/30 infected knee patients had >1 contraindication compared to 2/41 non-infected patients ($p=0.006$).

CONCLUSIONS: A high percentage of patients undergoing early revision arthroplasty had at least one modifiable risk factor for a primary joint replacement. Joint replacement surgeons may help reduce revision surgery through counselling and appropriate referral for modification of risk factors.

Is Indwelling Urinary Catheter Necessary for Total Joint Arthroplasty Using Epidural Anesthesia?

Abstract ID: Paper 150

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BACKGROUND: Indwelling urinary catheters are often used during total joint arthroplasty (TJA) to monitor fluid balance and urinary output. The use has previously been indicated during neuraxial anesthesia to prevent overdistention and risk of permanent bladder dysfunction. The objective of this study is to evaluate the necessity of urinary catheterization for TJA using epidural anesthesia.

METHODS: 335 consecutive patients who underwent primary TJA using epidural anaesthesia were retrospectively reviewed. The initial 103 patients received a preoperative urinary catheter which was maintained until the morning of postoperative day 1. The subsequent 232 patients did not receive a preoperative urinary catheter. Demographics, medical comorbidities, genitourinary [GU] comorbidities, postoperative GU complications, length of stay, and discharge disposition were compared between groups. T-tests were used to compare continuous variables and chi-square tests were used to compare categorical variables between groups ($p=0.05$).

RESULTS: There were no differences in demographics between groups: age (Catheter [C] 65.4 ± 10.9 , No Catheter [NC] 65.6 ± 11.1 , $p=0.881$), gender (C 38.8% male, 34.9% male, $p=0.571$), or laterality of surgery (C 45.6% right, 45.3% right, $p=0.956$). There was a difference in type of surgery performed (C 43.7% knee, NC 59.9% knee, $p=0.008$). There was no difference between groups in ASA (C 2.5, NC 2.6, $p=0.2$), but there was a difference between groups in BMI (C 30.0 ± 5.0 , NC 31.6 ± 5.3 , $p=0.01$). There were no differences in GU comorbidities between groups: % males with benign prostatic hyperplasia (C 25.0%, 17.3%, $p=0.448$), % males with prostate cancer (C 5.0%, 9.9%, $p=0.572$), % patients with preoperative urinary urgency (C 3.9%, NC 2.2%, $p=0.592$), % patients with preoperative urinary incontinence (C 0%, NC 1.3%, $p=0.596$). There were no differences in postoperative GU complications between groups: overall rate of GU complication (C 9.7%, NC 9.9%, $p=0.888$), urinary retention requiring discharge with urinary catheter (C 4.9%, NC 4.7%, $p=0.816$), urinary tract infection (C 5.8%, NC 2.6%, $p=0.249$). There were no differences in discharge disposition between groups (C 92.2% home, NC 95.7% home, 0.265). Postoperative genitourinary complications [POGC] were associated with increased median age in years (POGC 70, No POGC 65, $p=0.001$) and increased average length of stay in days (POGC 1.9, No POGC 1.3, $p<0.001$).

CONCLUSION: Patients undergoing total joint arthroplasty under epidural anesthesia demonstrate no increased risk of postoperative urological complications without the placement of preoperative indwelling urinary catheter. The routine use of preoperative catheters can be reconsidered for this mode of anesthesia.

Rapid Recovery Total Joint Arthroplasty Protocol in the Veterans Administration Setting: Is it Effective?

Abstract ID: Paper 151

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INTRODUCTION: Institutional clinical pathways for total joint arthroplasty (TJA) have been shown to reduce costs and provide better care. The purpose of this study was to evaluate the effect of a comprehensive perioperative TJA protocol on quality of care in a Veterans Health Administration (VA) hospital setting.

METHODS: In a VA hospital, a perioperative protocol was implemented for patients receiving a primary total hip or knee arthroplasty. This protocol emphasized preoperative education, standardization of dressings, multimodal pain management techniques, accelerated physical therapy, and early discharge from the hospital. Patients who had surgery the year prior to the protocol (pre-protocol group, n=174 patients) were compared to patients who received their surgery after implementation of the protocol (post-protocol, n=78 patients). Outcomes of interest included LOS, discharge destination, unplanned readmissions, and overall complications.

RESULTS: Patient characteristics were similar between cohorts with the exception of lower BMI (32.7 vs 30.9 kg/m², p=0.02) and a higher prevalence of stroke history in the post-protocol group (1.7% vs 7.7%, p = 0.03). After the protocol, the average LOS significantly decreased from 3.2 days to 1.7 days (p<0.0001). Prior to the protocol, 85.1% of patients discharged home, 14.4% discharged to skilled nursing facility (SNF) and 0.6% to rehab. After the protocol was implemented, 97.4% of patients discharged home and 2.6% discharged to SNF (p = 0.005). There were differences in incidence of unplanned readmission (6.3% vs. 3.8%) and overall complications (7.5% vs. 3.8%).

CONCLUSIONS: A perioperative TJA protocol can be effective and safely implemented in a VA hospital setting, resulting in improvements in hospital LOS and discharge disposition without affecting readmission or complication rates. Such protocols are important for improved patient care and are also essential for cost control as we transition to an era of value-based arthroplasty.

No Difference in Events After Total Joint Arthroplasty Between Dabigatran and Warfarin for Thromboprophylaxis

Abstract ID: Paper 152

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INTRODUCTION: Warfarin is the gold standard for anticoagulation in patients with atrial fibrillation (afib) as well as thromboprophylaxis following total joint arthroplasty. Dabigatran is a newer oral anticoagulant that does not require laboratory monitoring and has demonstrated efficacy similar to that of warfarin in patients with afib. However, the safety or efficacy of dabigatran for thromboprophylaxis following total joint arthroplasty has not been compared to that of warfarin. Our aim was to determine if there is there an increased risk of bleeding or thrombosis-related events with dabigatran versus warfarin for thromboprophylaxis following total joint arthroplasty in patients with afib.

METHODS: We utilized a retrospective matched cohort study design. Our source population was all patients who underwent primary total joint arthroplasty at our institution from 2010 to 2013 (n=18,388). Forty-four patients who were administered dabigatran for afib preoperatively as well as for thromboprophylaxis postoperatively were identified. Each of these patients were matched 1:3 by surgeon, type of surgery, and age to patients who were administered warfarin (n=132) for afib preoperatively as well as for thromboprophylaxis postoperatively. We performed a chart review and recorded the following bleeding or thrombosis-related events: change in hemoglobin, allogeneic blood transfusion, antibiotics prescribed for the operative site, and mortality as an in-patient; readmission, deep venous thrombosis (DVT), and pulmonary embolism (PE) within the 30-day postoperative period; and reoperation for hematoma or infection. Conditional logistic regression analysis was performed for binary outcome variables. For continuous outcome variables, mixed-effects modeling was performed considering correlations within each pair. $p < 0.05$ was considered significant. The power to detect a difference in readmission rate greater than 10% was > 0.80 .

RESULTS: There was no difference in average hemoglobin decrease by postoperative day 1 between patients administered dabigatran or warfarin ($p=0.56$). There was no difference in number of patients requiring blood transfusion as an inpatient between those anticoagulated with dabigatran or warfarin ($p=0.11$). Among warfarin patients, one required readmission for delayed wound healing, and another required antibiotics for the operative site. None of the patients in our study required reoperation, were diagnosed with DVT or PE, or died as an inpatient.

CONCLUSION: We did not observe a difference in rates of bleeding or thrombosis-related events between dabigatran and warfarin when used for thromboprophylaxis following total joint arthroplasty in patients with afib. Our study suggests patients on dabigatran for afib preoperatively may safely continue this agent for thromboprophylaxis following total joint arthroplasty.

Is Obesity the Same Risk Factor For Total Hip and Total Knee Replacement?

Abstract ID: Paper 153

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INTRODUCTION: Obesity has previously been demonstrated to be an independent risk factor for increased complications following both total hip (THA) and total knee arthroplasty (TKA). However, it is unknown whether obesity confers a disproportionately higher risk for complications when comparing TKA and THA. Therefore, the purpose of this study was to compare the effect of obesity on postoperative complications after THA and TKA to determine whether the effect was similar for both procedures.

METHODS: We queried the American College of Surgeons National Surgical Quality Improvement Program (ASC NSQIP) database to identify patients who underwent primary THA or TKA between 2006 and 2014. Patients were defined as obese if their body mass index was $>30 \text{ kg/m}^2$. Patients were stratified by operation type and presence of obesity. Thirty-day rates of any complication, wound complications, deep infection, and reoperation were compared between cohorts using univariate analysis and multivariate logistic regression to control for demographic and comorbidity differences between cohorts.

RESULTS: We identified 162,739 patients who underwent primary THA or TKA. Of these, 44.4% of THA patients ($n = 28,924$) and 61.9% of TKA patients ($n = 60,231$) were obese. The average BMI for the obese population was 35.7 kg/m^2 for THA and 36.9 kg/m^2 for TKA ($p < 0.001$). Univariate analysis demonstrated obese patients undergoing THA had increased rates of wound complications (1.8% vs. 1.1%), deep infection (0.4% vs. 0.2%), overall reoperation rate (2.4% vs. 1.2%), and any complications (5.6% vs. 4.9%) when compared to obese TKA patients ($p < 0.001$ for all). Multivariate regression analysis identified obese THA patients to have significantly increased risk of wound complications (odds ratio [OR], 1.6; 95% confidence interval [CI], 1.4 to 1.8), and deep infection (OR 2.2; 95% CI, 1.7 to 2.8) compared to the obese TKA cohort. Additionally, obese THA patients also had a significantly increased risk of overall reoperation (OR 2.0; 95% CI 1.8 to 2.3) and any complication (OR 1.2; 95% CI, 1.1 to 1.3) relative to the obese TKA patients.

CONCLUSION: Obesity is a well-established risk factor for complications following THA and TKA. This study demonstrates the impact of obesity on complications following surgery is much more profound for THA procedures than TKA. These findings highlight the importance of considering both patient comorbidities and procedure type when evaluating patients for surgery. Additionally, the conferred risk of specific comorbidities, including obesity, on postoperative outcomes must be considered when developing risk-adjusted models for bundled payment initiatives.

Are We Appropriately Compensated by Relative Value Units for Primary vs. Revision Total Hip Arthroplasty?

Abstract ID: Paper 154

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INTRODUCTION: In today's value driven healthcare system, it is imperative for physicians to maximally optimize the value of their services provided to their patients. This maximization allows for better patient care, improved patient satisfaction, and can even alter physician compensation. Relative Value Units (RVUs) are a method to evaluate the effort required for providing a service to patients in order to determine compensation. The purpose of this study was to compare the mean RVU to mean operative times in primary and revision total hip arthroplasty (THA) in order to help identify which procedures provide the most reimbursement for a physician's operative time.

METHODS: The American College of Surgeons, National Surgical Quality Improvement Program database from 2008 to 2015 was consulted to identify hip arthroplasty patients. There were 104,039 patients who underwent primary total hip arthroplasty (CPT code 27130) and 7,283 patients who underwent revision total hip arthroplasty (CPT code 27134). Mean RVU and operative times (minutes) as well as RVU/minute for each cohort were calculated and compared.

RESULTS: For the primary THA cohort, the mean RVU was 21.2 (± 0.53 , 20.72 to 21.79), mean operative times were 95 minutes (± 41 , 30 to 1387), and mean RVU/minute was 0.260 (± 0.09 , 0.016 to 0.73). For the revision THA cohort, the mean RVU was 30.3 (± 0.03 , 30.13 to 30.28), mean operative times were 154.0 minutes (± 81 , 30 to 962), and mean RVU/minute was 0.248 (± 0.12 , 0.03 to 1.0). Statistical analysis between the two groups showed a difference for greater RVU and operative times for revision cases. Most interestingly though, the RVU/minute was statistically greater for primary THA than it was for revision THA ($p < 0.001$).

CONCLUSION: While the published RVUs may indicate an overall greater compensation for physicians performing revision THA, a metric that might be of more importance is the RVU/minute. Though it might be assumed that since revisions are more complex cases requiring more operative time and greater aftercare compensation would be greater, such is not the case. The results from this study indicate a statistically significant difference between the RVU/minute for primary (0.260) and revision THA (0.248), such that it is more financially

beneficial for orthopedic surgeons to perform primary THAs over revisions. Orthopedists can use this data in configuring their practices in order to generate a greater a greater return. These data should also prompt a review of how physicians are compensated for more difficult and complicated cases.

MAOA BREAKOUT SESSION #12
PEDIATRICS/SPINE
April 21, 2018

Derotational Pronation-Producing Osteotomy of the Radius and Biceps Tendon Rerouting for Supination Contractures

Abstract ID: Paper 155

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BACKGROUND: Forearm supination contractures can occur as a result of neurologic derangement of the upper extremity. Primarily, this is observed in patients with neonatal brachial plexus birth palsy. The contractures develop slowly over time and become problematic in childhood as forearm pronation becomes necessary for activities of daily living including typing on a keyboard, holding utensils and writing. To correct this deformity, a radial osteotomy to realign the forearm in resting pronation is combined with a biceps tendon rerouting to prevent recurrence. This is the largest case series to date describing outcomes of this technique.

PATIENTS AND METHODS: A retrospective review identified patients who had a radial osteotomy and biceps rerouting for supination contracture between 2006 and 2016. Inclusion criteria included forearm supination contracture, patients <18 years of age, and at least 6 months of clinical and radiographic follow-up. Demographic and surgical variables, clinical outcomes, complications, reoperations, and revision were documented.

RESULTS: There were 22 patients identified who met inclusion criteria. Of these, the indication for surgery was neonatal brachial plexus birth palsy in 19 patients (86%), poliomyelitis in 2 patients (9%), and traumatic nerve injury in 1 patient (5%). The mean follow-up was 3 years (range, 6 months – 9 years). There was a statistically significant difference in resting forearm position from an average of 70° arc of motion from an average of 56° supination preoperatively to 14° of pronation postoperatively ($p < 0.01$). Correspondingly, there was an increase in passive forearm pronation from 0° preoperatively to 66° postoperatively ($p < 0.01$) and expected decrease in passive forearm supination changed from 78° preoperatively to 41° postoperatively ($p < 0.01$). In total, there no complications. Excluding revisions, there were 15 reoperations in 14 patients (63%) including 14 for hardware removals and 1 FCU to ECRB tendon transfer for the flexion contracture of the wrist. There were 2 revisions for osteotomy nonunion, both of which went onto eventual union. Overall survivorship free from revision surgery was 95% at 12 months, 88% at 24 months, and 88% at 60 months.

CONCLUSIONS: These are results of a novel surgical solution for forearm supination contracture through the combination of a derotational osteotomy of the radius and biceps tendon rerouting. There is a significant benefit in forearm positioning and passive pronation with excellent survivorship. This is the first study to document this technique and thus the largest series to date to report outcomes after such surgical intervention for supination contracture.

Anterior (Smith-Petersen) Approach for Open Reduction and Internal Fixation of Acute Unstable Slipped Capital Femoral Epiphysis

Abstract ID: Paper 156

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PURPOSE: Various treatment options have been described for treatment of acute unstable slipped capital femoral epiphysis (SCFE). Avascular necrosis (AVN) is a risk with any form of treatment, but wide ranges of AVN rates have been reported in the literature. Published rates of AVN range from 5-50% in patients treated with open reduction of an unstable SCFE by various methods. The purpose of this study is to report the AVN rate of a group of patients with acute, unstable SCFE treated with ORIF through an anterior (modified Smith-Petersen) approach.

METHODS: A cohort of patients treated with ORIF through an anterior approach for a documented acute, unstable SCFE, were compiled from a list of all SCFE patients seen at the authors' institution for 2009-2016. Clinical records and radiographs were reviewed, and data was collected for routine demographics, co-morbidities, timing of injury and treatment, type of approach, type of fixation used, any other procedures performed, and development of AVN, chondromalacia or other complications.

RESULTS: Twelve patients (mean 11.6y) were identified that were treated with ORIF of an acute, unstable SCFE through an anterior modified Smith-Petersen approach. All were fixed with large (7.0 mm or greater) cannulated screws. Three patients had concurrent osteochondroplasty. Mean follow-up was 1.9 years postoperative, with one patient lost to follow-up. Of the remaining 11 patients, none developed radiographic signs of AVN, and none had significant loss of range of motion. There was no documented chondromalacia or infections. No patients required additional surgery beyond hardware removal.

CONCLUSION: Treatment of acute, unstable SCFE by ORIF via an anterior approach is shown to be safe and effective in this series of patients. There were no significant complications and this cohort had a lower AVN rate than what has been previously reported

SIGNIFICANCE: Acute, unstable SCFE patients have historically faced an extremely high risk of AVN, a result with potentially devastating long-term consequences. ORIF via an anterior (modified Smith-Petersen) approach has become the treatment of choice for the authors of this paper. First, because it utilizes an approach that is more familiar to all orthopedic surgeons than a surgical hip dislocation and is more direct than the anterolateral (Watson-Jones) interval. Second, and more significantly, it has demonstrated a lower rate of AVN in this series. This approach also allows for simultaneous osteochondroplasty (femoroplasty) of realized or suspected areas of impingement after reduction of the acute component of an 'acute-on-chronic' SCFE.

Intrauterine Random Premature Physeal Arrest: Case Report and Literature Review

Abstract ID: Paper 157

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Fetal intrauterine premature random partial or complete physeal arrest; is that possible? This paper presents a fetus with intrauterine vascular insufficiency of an upper extremity present at birth, who subsequently developed multiple random premature physeal arrests, all distal to the site of the vascular insufficiency. Some of the physeal arrests were complete, some partial, and some physes remain normal. The distal humerus, proximal and distal radius, and distal ulna all have complete physeal arrests with little or no subsequent ossification of their epiphyseal ossification centers. The thumb metacarpal proximal physis has a central physeal bar, and the index finger metacarpal distal physis has a physeal bar equivalent (premature partial physeal arrest without a bone bar). The lateral three metacarpal and all phalangeal physes remain open and growing at age 7 years 1 month. The metacarpal physeal bar and physeal bar equivalent were excised at age 7 years 1 month. The result of the surgery and the ultimate limb deformity may not be known for several years.

Although neither the exact dates, nor the age of the fetus at the time of the intrauterine injuries are known, the radiologic identification of metaphyseal-physeal abnormalities at multiple sites at age 32 days of life, represents the youngest recorded patient with this syndrome to have comparison x-rays and multiple documented random traumatic physeal arrests. This is also the first recorded patient with intrauterine vascular deficiency to have surgical excision of either a physeal bar or a physeal bar equivalent.

Charge Analysis of Closed Femur Fractures in 3-6 Year-Olds Treated with Spica Cast vs. Intramedullary Fixation

Abstract ID: Paper 159

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PURPOSE: Healthcare in America continues to place more importance on providing value-based medicine. Medicare reimbursements are increasingly being tied to this and future policy changes will reinforce these trends. Recent literature has shown pediatric femur fractures in 3-6 year-olds have equivalent clinical and radiographic outcomes when treated with spica casting or flexible intramedullary nails. We compared hospital charges related to the above treatments for closed femur fractures in 3-6 year-olds.

METHODS: An IRB-approved retrospective chart review was performed of 73 consecutive 3-6 year-olds treated at a regional level one pediatric hospital from 1/1/2009 to 12/31/13 with an isolated, closed femoral shaft fracture. Exclusion criteria included open fractures, bilateral injury, and polytrauma. Professional charges included orthopedic surgeons, anesthesiologists, and emergency physicians.

RESULTS: 41 patients were treated with spica cast, 32 patients treated operatively with flexible intramedullary nails. 3 patients failed nonoperative care. After analysis of final treatment groups, significant differences included age at injury: 3.7 years for cast vs. 5.3 years for IMN ($p<0.001$), time to discharge 21 vs. 41 hours ($p<0.001$), 3.2 vs. 4.4 clinic visits ($p<0.001$), follow-up 3.5 vs. 9.4 months ($p<0.001$). Orthopedic surgeon charges were \$1,500 for casted patients vs. \$5,500 for IMN ($p<0.001$). Total hospital charges were \$19,200 for cast vs. \$59,700 for IMN ($p<0.001$). No difference was found between clinic charges or number of x-rays between the groups. 76% of cast group were discharged <24 hours from admission vs. only 8.6% in operative group. 100% of cast group was discharged within 48 hours vs. 93.6% in operative group. In the operative group, 83% had implant removal with no significant charge difference between those who had implant removal vs. retention.

CONCLUSION: The treatment of pediatric femur fractures in 3-6 year-olds with intramedullary nailing is associated with significantly longer hospital stays, greater hospital charges, longer follow-up, and more clinic visits compared to spica casting. These findings are at odds with previous literature showing shorter hospital stays and decreased cost with nailing compared to casting. This data shows a clear charge difference between two treatments that yield similar clinical and radiographic outcomes. Given the small subgroup that did not have hardware removed, we did not find a significant difference in charges for implant removal.

SIGNIFICANCE: Value-based medicine is rapidly becoming a powerful force in the United States health system and procedures that result in equivalent patient outcomes will increasingly be scrutinized based on economic impact.

Surgical Management of Idiopathic Clubfoot in the United States from 1997-2012: An Analysis of 11,940 Discharges

Abstract ID: Paper 160

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INTRODUCTION: With the introduction of the Ponseti Method in the late 1990s, rates of operative intervention of clubfoot within the first year of life have significantly declined. However, operative procedures for clubfoot continue to be routinely performed in the United States. Our purpose was to analyze trends in the operative management of clubfoot in the U.S., including total costs from 1997-2012.

METHODS: The Healthcare Cost and Utilization Project (HCUP) Kids' Inpatient Database was used to identify discharges associated with idiopathic clubfoot (ICD-9-CM diagnosis codes 754.70 and 754.51) and one or more of 28 corrective surgeries between 1997 and 2012. Patients were divided into subgroups of ages 0 to <1 and 1 to 18. Variables analyzed included number of operative procedures, hospital charges, and length of stay.

RESULTS: There were 11,940 discharges (~65% Male) with a clubfoot diagnosis and clubfoot procedures identified in the study period. In the first year of life, total procedures decreased approximately 92% from 1997-2012 (2153.6 ± 205.6 to 177.2 ± 27.7 , $p=0.0067$). Total number of procedures remained steady in the 1-18 age group (2644.5 ± 285.4 to 1923.9 ± 203.2 , $p=0.0969$) from 1997-2012. Eighty-six percent of all procedures were done after the first year of life. The average number of clubfoot procedures per patient ages 0-<1 did not significantly decrease from 1997 (1.26 ± 0.04) to 2012 (1.17 ± 0.05 , $p=0.2095$). The average number of clubfoot procedures per patient ages 1-18 significantly increased from 1.61 ± 0.04 in 1997 to 1.74 ± 0.03 in 2012 ($p=0.0005$). Over the same time period, the number of hospital stays for clubfoot procedures decreased in both age groups (both $p<0.05$). Average hospital length of stay increased from 1.98 ± 0.17 to 3.01 ± 0.45 ($p=0.016$) from 1997 to 2012. Mean hospital charges increased on average $\$5802.6 \pm 744.7$ every three years ($p<0.0001$) totaling $\$46,826.0 \pm 5,800.3$ per hospitalization in 2012.

CONCLUSION: Over the 15-year period analyzed, there was a significant decrease in clubfoot operative procedures in the first year of life. In contrast, the average number of per patient club foot procedures increased and total procedures remained steady in the 1-18 age group. Mean charges for operative clubfoot procedures have increased totaling nearly 700 million from 1997-2012. These data suggest a break from the Ponseti Method after the first year of life and a trend towards operative preference in management of clubfoot in patients ages 1-18.

Efficacy of Preoperative Antibiotic Therapy in Pediatric Supracondylar Fractures Treated with Closed Reduction and Percutaneous K-Wire Fixation

Abstract ID: Paper 161

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BACKGROUND: Controversy exists surrounding antibiotic use in the setting of supracondylar humerus (SCH) fractures treated with closed reduction and percutaneous k-wire fixation (CRPP). While the reported rate of infection in the literature is low, surgeons frequently administer preoperative antibiotics. The purpose of this study was to retrospectively review antibiotic use and infection rates in children with SCH fractures treated with CRPP. It was hypothesized that antibiotic administration will not affect infection rates following this procedure.

METHODS: Following IRB approval, a retrospective review was conducted of 899 patients with SCH fractures treated with CRPP at one institution between 2006 and 2015. Patient demographics, antibiotic administration, and follow-up data were reviewed in 223 patients were reviewed for provisional analysis and reporting.

RESULTS: Of 223 patients, 132 patients received antibiotics preoperatively and 91 patients did not. The infection rate in the group that received preoperative antibiotics was 1.5% (n=2) and 3.3% (n=3) in the group that did not receive preoperative antibiotics. The overall infection rate was 2.2%. In review of the 5 infections treated with oral antibiotics, 2 of the 5 patients' casts were removed early by family (n=1) or were removed early due to water exposure (n=1). Signs of infection for those five patients included, fever (n=1), edema (n=2) inflammation at pin site (n=4), and clear drainage (n=1). All of the infections were superficial and successfully treated with oral antibiotics only.

DISCUSSION/CONCLUSION: Preliminary results of SCH fractures treated with CRPP at one institution demonstrated that perioperative antibiotic administration had no effect on the rate of infection (p=0.40). This data is consistent with the current literature. Despite these trends, many surgeons continue to administer prophylactic antibiotics for CRPP of SCH fractures. Even within this institution, there is inconsistent administration of perioperative antibiotics among surgeons. Continued review of remaining patient cohort is needed for improved study power and analysis.

Open Reduction and Internal Fixation for Osteochondritis Dissecans of the Femoral Head in Patients with Legg-Calvé-Perthes Disease

Abstract ID: Paper 162

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INTRODUCTION: Osteochondritis dissecans (OCD) of the femoral capital epiphysis is estimated to occur in 2-7% of patients with Legg-Calvé-Perthes disease (LCPD). Unstable osteochondral fragments secondary to LCPD may produce pain, hip dysfunction, and mechanical symptoms severe enough to warrant surgical intervention. Clinical outcomes following surgical hip dislocation and ORIF of the post-Perthes osteochondral fragment have not been reported. The purpose of this study is to report short-term patient-reported outcomes and radiographic osteochondral fragment healing after ORIF for the treatment of symptomatic osteochondral lesions resulting from LCPD.

METHODS: All patients underwent preoperative radiographs and MRI confirming an unstable OCD fragment. All patients underwent a surgical hip dislocation with a transverse trochanteric osteotomy followed by ORIF of the femoral head osteochondral fragment with headless compression screws. Concomitant procedures included femoral head/neck osteochondroplasty and ligamentum teres debridement in all patients, with additional procedure performed as indicated. The greater trochanter was typically advanced approximately 5 mm, and in two cases a more substantial advancement was performed. Pre- and postoperative modified Harris Hip score (HHS), UCLA score, and Hip disability and Outcome Score (HOOS) were collected. Postoperative radiographs and clinical evaluations were performed at regular intervals.

RESULTS: From a total of 67 consecutive patients treated with hip preservation surgery for LCPD, seven patients (seven hips, 10%) with symptomatic OCD secondary to LCPD were treated with surgical hip dislocation and ORIF of the femoral head osteochondral fragment. Mean follow-up was 4.6 years (range 1.1-7.4 years). Patients described mechanical symptoms for an average of 12 months preoperatively (range 0.1-3.0 years). OCD size lesion ranged from 200 mm². Modified HHS improved from baseline to final-follow-up (47.8 to 82.7, \pm 34.9, MCID 11, $p=0.002$), with all patients meeting MCID for modified HHS. There were clinically significant postoperative improvements in HOOS&R and HOOSQOL. There was a significant postoperative improvement in internal rotation in flexion (5.0 ± 5.0 to 16.4 ± 9.8 , $p=0.02$). One patient underwent subsequent hip arthroscopy for recurrent pain at seven months postoperative. Radiographs demonstrated complete osteochondral fragment healing without implant failure and no progression of osteoarthritis in all patients at final follow-up. There were no complications.

CONCLUSION: ORIF of symptomatic unstable post-Perthes OCD lesions has been a very effective surgical approach in relatively younger patients. We advocate ORIF for symptomatic osteochondral lesions as a first-line surgical treatment for these patients due to the advantages of native osteochondral tissue preservation, predictable healing, and marked clinical improvement.

Operative Trends in Legg-Calve-Perthes Disease: An Analysis of 6,133 Discharges

Abstract ID: Paper 163

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INTRODUCTION: Despite extensive studies into the numerous methods of operative management of Legg-Calve-Perthes Disease (LCP), there remains a paucity of data characterizing what specific procedures are actually being performed. Our purpose was to analyze trends in the operative management of LCP from 1997-2012.

METHODS: The HCUP KIDS' Inpatient Database was utilized to identify discharges associated with Legg-Calve-Perthes Disease (ICD-9-CM diagnosis code 732.1) and one or more of 14 corrective surgeries between 1997-2012. Patients were divided into subgroups of ages 0-<4, 4-<8, 8-<12 and 12-18 (Age groups 1, 2, 3 and 4, respectively). Variables analyzed included number of operative procedures, length of stay, hospital charges, and demographics (age, gender). Variables were analyzed using standard statistical methods.

RESULTS: There were 6,133 discharges (21% female) with a LCP diagnosis and LCP procedures identified in the study period. 6,091 total procedures were performed (>75% in ages 4-<12). Femoral osteotomy, internal fixation, tenotomy, and acetabuloplasty made up >82% of total procedures (38.74%, 14.57%, 17.97% and 10.81% respectively). Greater than 75% of all procedures were performed in age groups two and three (36% and 39%, respectively). When combining all procedures together, there was no significant change in proportion of procedures by age. Femoral osteotomy and hip fusion decreased significantly from 1997-2012 in the second and fourth age groups respectively (OR=0.63, $p<0.001$; OR=0.90, $p=0.041$). There was a significant increase in internal fixation (age group 2 (OR=1.15, $p=0.043$) and 3 (1.16, $p<0.0115$), capsulotomy (age group 2, OR=1.24, $p=0.025$), total hip arthroplasty (age group 4, OR=1.319, $p<0.0015$), hip resurfacing (age group 4, OR=3.863, $p<0.0396$), acetabuloplasty (age group 4, OR=1.25, $p=0.007$), and femoral lengthening (age group 4, OR=1.57, $p<0.001$). Average total procedures per discharge was 2.48. Average length of stay was 2.51 and did not change over time ($p=0.506$). Average cost (all procedures) increased significantly by \$4,479.36 ($p<0.001$) every three years totaling an estimated \$160 million from 1997-2012.

CONCLUSIONS: Over the 15-year period analyzed, there was no significant change in total procedures performed for LCP. The male to female ratio was 5:1 with the majority of procedures being performed between the ages of 4 and <12 years old. Interestingly, there were significant changes in procedure types—most notably a decrease in femoral osteotomy and hip fusion and increases in internal fixation, capsulotomy, hip arthroplasty, and acetabuloplasty. Surprisingly, the latter procedural increase occurred in age group 4, suggesting a trend toward increasing operative procedures in ages 12-18.

Hip Core Decompression in Adolescents and Young Adults with Osteonecrosis of the Femoral Head Secondary to Glucocorticoid Treatment for Hematologic Malignancy

Abstract ID: Paper 164

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Osteonecrosis (ON) is a frequent complication of the treatment with glucocorticoids for lymphoid malignancies, especially pediatric acute lymphoblastic leukemia. Because little is known of the optimal treatment of this complication in children and adolescents, we reviewed our experience using core decompression with curettage and bone graft substitute for femoral head ON to ameliorate progression and/or symptoms in our cohort.

We reviewed preoperative magnetic resonance images and radiographs, used the Steinberg classification and hip effusion scores at time of core decompression, and assessed function and conservation of the hip at last follow-up.

Of 36 evaluable patients (17 males), mean age of 15.4 (range, 10-19) years at diagnosis of hematologic malignancy, 16.4 (range, 12-21) years at diagnosis of ON and 17.2 (range, 12-22) years at time of core decompression, 19 underwent bilateral and 17 unilateral core decompression. The mean follow-up was 54 (range, 12-111) months. Although 25 (69.4%) patients were receiving chemotherapy at the time of core decompression, none encountered perioperative complications. Arthroplasty was required in 28 of 55 hips (50.9%) at a mean of 20 (range, 5-72) months after core decompression. The 28 hips were coded as Steinberg IC in 11, IIB in 1, IIC in 2, IVB in 3, and IVC in 11; MRI effusion score was 3 in 13, 2 in 12, and 1 in three. The 27 hips not proceeding to arthroplasty had Steinberg scores of IA in 2, IB in 4, IC in 6, IIB in 5, IIC in 2, IVB in 1, and IVC in 7; and MR effusion scores of 3 in eight, 2 in 13, and 1 in six. Of 27 hips (18 patients) not proceeding to arthroplasty, 21 had no pain, 4 had mild pain, 2 mild to moderate pain, and none severe or 'worst pain' at a median of 43.3 (range, 12-111) months from core decompression. Fourteen patients (78%) participated in all desired activities; three were limited in sports only, and one in school and sports. Patients who received bone graft substitute containing demineralized bone matrix (DBM) had significantly lower rates of postoperative progression and conversion to arthroplasty (13 of 33 vs. 15 of 22 hips, $P=0.032$).

Core decompression salvaged 37.2% of hips with large lesions (Steinberg C) or evidence of femoral head collapse (Steinberg III or greater) and offers symptomatic improvement and potential hip preservation. The procedure is safe with no perioperative complications even in patients undergoing concomitant chemotherapy.

A Randomized Prospective Trial of Intravenous and Oral Tranexamic Acid in Lumbar Spinal Fusion: Same Effect But Different Cost?

Abstract ID: Paper 165

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INTRODUCTION: Due to the significant risks and complications associated with blood loss and allogenic transfusions, efforts to identify safe and effective ways of lowering blood loss during spine surgery are crucial. Tranexamic acid (TXA) is effective in reducing blood loss and transfusion rate after spinal fusion. Although intravenous (IV) TXA has been shown to be successful in patients undergoing spine surgery, no studies in the literature have investigated the efficacy of oral (PO) TXA, which is at a fraction of the cost of its IV counterpart. The purpose of this randomized prospective trial is to determine if PO TXA is equivalent to IV TXA in reducing blood loss in spinal fusion.

METHODS: In this randomized prospective trial, patients undergoing thoracolumbar fusion were randomized to receive 1.95g of TXA orally 2 hours preoperatively or 2g IV TXA (1g before incision and 1g before wound closure). The primary outcome was reduction of hemoglobin. In addition, calculated blood loss, case length and intraoperative/postoperative complications were investigated. Power analysis determined that 30 patients were needed in each group. We planned to collect a sample size of 50 patients in each group. This sample is further sub-stratified into 3 categories based on number of levels fused (1-2 level fusions, 3-5, and >5). Equivalence analysis was performed with pooled and Welch two one-sided test. A P-value of <0.05 suggests equivalence between treatments.

RESULTS: Preliminary data have included 50% of intended sample size. In this pool, 23 patients received IV TXA and 25 patients received PO TXA. There is a trend towards equivalence in the mean reduction of hemoglobin between IV and PO groups (3.48g/dL vs 3.26g/dL, respectively; $P = 0.08$, equivalence). We predict that the current sample size is not yet large enough to detect a statistical significance. However, a statistically significant equivalence can be achieved between treatments with our large sample size by the study conclusion.

DISCUSSION AND CONCLUSION: IV and PO TXA are both effective in reducing the expensive perioperative costs associated with blood loss and transfusions after spinal fusions. Oral TXA provides equivalent reductions in blood loss, at a cost of \$14 compared with the \$500 cost for IV formulation. As the incidence of spinal fusions increases in the near future, adapting an oral regimen of TXA can drastically decrease cost for our health care system.

Can the American College of Surgeons Risk Calculator Predict 30-Day Complications After Cervical Spine Surgery?

Abstract ID: Paper 166

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INTRODUCTION: Surgical risk calculators exist in many fields and may assist in the identification of patients at increased risk for complication and readmissions. Risk calculators may allow for improved outcomes, an enhanced informed consent process, and management of modifiable risk factors. The American College of Surgeons (ACS) NSQIP risk calculator was developed from a cohort of over 1.4 million patients, using 2,805 unique CPT codes. The risk calculator uses 21 patient predictors (e.g., age, ASA class, BMI, HTN) and the planned procedure (CPT code) to predict the chance that patients will have any of 12 different outcomes (e.g., death, any complication, serious complication, reoperation) within 30-days following surgery. The purpose of this study is to determine if the ACS NSQIP risk calculator can predict 30-day complications after cervical fusion.

METHODS: A retrospective chart review was performed on patients that underwent primary cervical fusion between January 2009-2015 at a single-institution, utilizing cervical fusion CPT codes (22554, 22590, 22595, 22600). Patients without 30 days postoperative follow-up were excluded. Descriptive statistics were calculated for the overall sample, anterior vs. posterior fusion, and single vs. multi-level fusion. Logistic regression models were fit with actual complication occurrence as the dependent variable in each model and ACS estimated risk as the independent variable. The c-statistic was used as the measure of concordance for each model. ROC curves were plotted to visually depict the predictive ability of the estimated risks. Acceptable concordance was set at $c > 0.80$. All analyses were conducted using SAS v9.4.

RESULTS: A total of 404 patients (207 anterior, 197 posterior) were included in the analysis. Because there were no deaths, no models were fit for mortality. Only "Any complication" and "SNF/Rehab Admission" met the criteria for $c > 0.80$ for acceptable concordance between ACS prediction and actual occurrence.

Logistic regression results were performed on the anterior and posterior fusion groups separately. Prediction was better in the anterior group for "Any complication", "SNF/Rehab admit", and "Serious complication" than in the posterior group. While complications occurred at a higher rate in the posterior group, the ability of the risk calculator to predict complications was poorer. Logistic regression results comparing single-level and multi-level fusion group illustrated that prediction was better in the single-level group for "SNF/Rehab admit", although prediction was still acceptable ($c > 0.80$) in the multilevel group.

CONCLUSION: The ACS risk-calculator only predicted complications in the categories of "any complication" ($p < 0.0001$) and "discharge to skilled nursing facility" ($p < 0.001$). However, the ACS risk calculator was unable to accurately predict specific complications on a more granular basis.

The ACS risk calculator may be useful in the development of new institutional strategies for cervical spinal fusion but does not provide accurate information for individual patient care.

Computer-Assisted Navigation in Posterior Lumbar Fusion Increases Operative Time and Length of Stay

Abstract ID: Paper 167

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INTRODUCTION: Computer-assisted navigation in lumbar spine surgery has been commercially available since 2000 and has been reported to reduce patient radiation exposure, transpedicular screw insertion errors, and decrease operative time. Adoption rates for navigation in posterior lumbar fusion are unknown, and it is important to determine the impact of navigation on patient outcomes and quality metrics in the 30-day postoperative period.

METHODS: The American College of Surgeons National Quality Improvement Program (ACS NSQIP) database was queried from 2011-2015 to identify patients that had undergone elective posterior lumbar spinal fusion. Cases with clean-contaminated, contaminated, or dirty/infected wound class were excluded from analysis. Patients were stratified based upon documentation of intraoperative Computer-Assisted Navigation (CAN). Demographics including patient age, gender, race, BMI, diabetes mellitus, smoking status, and medical comorbidity were assessed for potential confounding variables. Operative variables including resident involvement and number of vertebral segments fused were also assessed. We evaluated navigation rates by year to evaluate navigation adoption rates. Propensity score matching was used to reduce patient selection bias for comparison of 30-day complication rates between the navigated and traditional lumbar spine fusion groups.

RESULTS: There were 25,010 patients in the cohort, with 1,812 (7.2%) cases involving CAN. CAN adoption rates increased from 3.4% in 2011 to 9.6% in 2014. Utilization in the most recent study year, 2015, was 7.2%. Short-term complications occurred in 1,973 cases (8.6%). After propensity score matching, operative time was increased 14 minutes in the navigated group (222.0 vs. 205.7 min, $p < 0.0001$). Length of hospital stay was significantly longer in the navigation group (3.72 vs. 3.47 days, $p = 0.0092$). There was no difference in all cause short-term complications between navigated and non-navigated posterior lumbar spinal fusion cases (7.17% vs. 7.23%, $p = 0.9488$).

DISCUSSION: This study demonstrates steady increase in rates of computer-assisted navigation in posterior lumbar fusion from 2010 to 2014. CAN resulted in longer operative time and longer length of hospital stay. There were no differences in all cause short-term complications between navigated and non-navigated posterior lumbar spinal fusion. While computer-assisted navigation is safe to use in lumbar spine surgery, it is unclear if the increased cost and time associated with this technology provide benefits warranting its use in routine lumbar spine surgery.

PROMIS Physical Function and Pain Correlation with ODI and VAS Pain in the Surgical Patient Population with Lumbar Stenosis and Claudication

Abstract ID: Paper 169

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BACKGROUND: Legacy patient reported outcome measures such as ODI (Oswestry Disability Index) and VAS (Visual Analog Score) are essential for analyzing treatments for lumbar stenosis with claudication. Administrative burdens impose limits on completion of such measures. The Patient Reported Outcomes Measurement Information System (PROMIS) group developed a patient outcome measure to improve reporting of symptoms and function and to reduce administrative burden. ODI and VAS have not been compared with PROMIS in patients with lumbar stenosis with claudication. The aim of this study is to compare ODI and VAS with PROMIS physical function and pain to determine their correlations in a surgical patient population.

METHODS: 108 patients with a diagnosis of lumbar stenosis with claudication that went on to surgery were included. All patients were treated at the same spine center by four spine surgeons. Patients were seen and PROMIS, ODI, and VAS scores were collected preoperatively, at 1-4 months, and at 6 months. Correlations between ODI and VAS with PROMIS physical function and pain were quantified using the Pearson correlation coefficient. Students t-tests were used to show correlation significance ($\alpha = 0.05$).

RESULTS: All 108 (100%) of patients completed baseline preoperative questionnaires. 65 (60%) of patients completed questionnaires at 1-4 months and 34 (31%) patients at 6 months. PROMIS physical function and ODI demonstrated a strong negative correlation, with Pearson r values of (-0.69, -0.73, -0.62) at baseline, initial follow-up, and 6 months. PROMIS pain and VAS back pain demonstrated an inconsistent correlation, with Pearson r values of (0.45, 0.53, 0.74) at baseline, initial follow-up, and 6 months. PROMIS pain and VAS leg pain demonstrated an inconsistent correlation, with Pearson r values of (0.39, 0.41, 0.61) at baseline, initial follow-up, and 6 months. Students t-test showed a P value of <0.0001 for all calculations.

CONCLUSIONS: PROMIS physical function scores have a strong negative correlation with ODI scores at baseline and in the postoperative course in patients undergoing surgery for lumbar stenosis with claudication. PROMIS pain scores have an inconsistent correlation with VAS back and leg pain scores. Surgeons may factor these outcomes into the delivery and interpretation of outcome measures in this population. Use of PROMIS physical function for this patient population may improve completion of outcome measures in the office while still providing reliable data, while use of PROMIS pain scores may not represent a consistent reliable alternative for pain assessment.

The Impact of Multiple Patient-Reported Allergies on Clinical Outcomes After Anterior Cervical Discectomy and Fusion

Abstract ID: Paper 170

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BACKGROUND CONTEXT: Anterior cervical discectomy and fusion (ACDF) is a viable treatment for degenerative cervical spine disease. Multiple patient-reported allergies (PRAs) have been shown in the hip and knee arthroplasty literature to be associated with poor clinical outcomes. This relationship has not been studied in the cervical spine literature. The purpose of this study was to assess the impact of multiple patient-reported allergies on patient-reported outcome (PRO) measures following ACDF.

MATERIALS/METHODS: This was a retrospective cohort study of 86 adult patients with a primary diagnosis of degenerative cervical spine disease with symptomatic myelopathy, radiculopathy, or myeloradiculopathy who underwent anterior cervical discectomy and fusion between June 2016 and April 2017. They were divided and studied into two groups: ≤ 1 allergy or ≥ 2 allergy. Patient demographics and surgical data were collected along with outcome measures, including PROMIS physical function (PF), pain (PI), depression, and Neck Disability Index questionnaires. Student's t-test was used for continuous variables and Fisher's exact test for categorical variables. A multivariate regression model was constructed to assess the impact of peri-operative variables on PROMIS physical function and pain outcomes. Significance was set at $p < 0.05$.

RESULTS: Patients with multiple allergies had more depression at baseline (54.75 vs. 48.99, $p=0.02$). Furthermore, they continued to have worse PROMIS depression scores at early follow-up (51.24 vs. 45.58, $p=0.03$). However, there was no significant difference between the ≤ 1 allergy and ≥ 2 allergy groups when comparing the change in all scores from the pre-operative to post-operative time period (Δ NDI -12.61 vs. -18.18, $p=0.20$; Δ PROMIS PF 4.54 vs. 7.40, $p=0.19$; Δ PROMIS PI -7.45 vs. -7.60, $p=0.95$; Δ PROMIS Depression -3.41 vs. -3.51, $p=0.97$). Regression analysis demonstrated no significant relationship between number of allergies and PRO measures.

CONCLUSIONS: Patients with multiple self-reported allergies had more depression at baseline compared to patients with 1 or no allergies. Their depression also did not significantly improve postoperatively. Contrary to hip and knee replacement studies, multiple allergies did not negatively affect postoperative PRO measures. Both groups had significant improvement in PROMIS physical function, pain, and NDI scores at early follow-up and the mean change from baseline in these measures was similar for the two groups. Surgeons can utilize multiple self-reported allergies as a potential indicator of depressive symptoms, but can expect similar improvement in PROs after ACDF for cervical degenerative disease.

Obesity and Patient Reported Outcomes Following Lumbar Spinal Stenosis Decompression: An Analysis of PROMIS CAT and ODI with Short-Term Follow-Up

Abstract ID: Paper 171

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PURPOSE/BACKGROUND: The effect of obesity on functional outcomes, depression, and patient satisfaction following lumbar spinal stenosis (LSS) decompression is controversial. The Patient Reported Outcomes Information Measurement System (PROMIS) employs computer adaptive testing (CAT) to evaluate patient-reported symptoms, function, and health-related quality of life. This study applies PROMIS data and the Oswestry Disability Index (ODI) to evaluate post-decompression outcomes in the obese LSS population.

METHODS: This is a retrospective review of the surgical treatment of LSS, by four surgeons at one institution, from August 2015 to October 2016. Patients were followed for 6 months postoperatively. Based on BMI, patients were divided into two groups: BMI <30, BMI >30. Postoperative PROMIS physical function (PF), pain interference (PI), and depression as well as ODI scores were compared to preoperative scores. Postoperative changes in these domains were compared between the two cohorts using two-way repeated measures ANOVA testing.

RESULTS: Ninety-four patients with LSS were included in this study: 49 obese (average BMI 34.49), and 45 non-obese (average BMI 25.46). There was no difference in age, gender, or number of levels decompressed between groups. For all study domains, there was significant postoperative improvement in both the non-obese [PF 4.22; PI -8.69; depression -2.72; ODI -12.01], and obese [PF 5.51; PI -9.87; depression -5.53; ODI -17.03] cohorts. No statistically significant difference in preoperative or postoperative scores for PF, PI, depression, or ODI was identified between cohorts. There was no significant interaction between obesity and postoperative change in PF ($p=0.291$), PI ($p=0.4961$), depression ($p=0.291$), or ODI ($p=0.1481$) at 6 months.

CONCLUSION: Decompression for LSS improved PROMIS PF, PI, depression, and ODI scores, with no significant difference between the obese and non-obese cohorts. Obese patients that undergo lumbar spine decompression see improved outcomes equivalent to their non-obese peers—elevated BMI should not be an independent limitation in patients indicated for LSS decompression.

Cervical Angiograms in Cervical Spine Trauma Patients Five Years After the Data: Has Practice Changed?

Abstract ID: Paper 172

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INTRODUCTION: Advanced diagnostic imaging utilizing CT technology has made angiography easier and faster to obtain in the trauma setting. Prior studies have shown that the rates of symptomatic vertebral artery injuries (VAI) are relatively low in the trauma population, approximately 0.1%, but that screening a broader population of asymptomatic trauma patients can increase the rate of injuries diagnosed to near 1%². While CT angiography (CTA) can readily provide a diagnosis, clinical significance of a positive result in polytrauma patients is limited by the high number of concomitant injuries limit the number of patients that are candidates for therapeutic anticoagulation or other treatments. At our institution, this had been described in a previous five-year study and the information disseminated between trauma attending physicians and the orthopedic department. We sought to retrospectively evaluate the patterns use of CTA in the trauma population at the authors' institution for the five years after this intervention was taken to evaluate for changes in practice.

METHODS: After IRB approval, 1,201 charts from 2011 to 2016 were reviewed at our Level 1 trauma hospital. Data collected included cervical injury type, neurologic examination, diagnostic testing performed, and any treatments or complications of VAI. This time frame begins after the prior study by Dreger et al. was completed and results of the study had been disseminated among the trauma and orthopedic faculty.

RESULTS: A total of 1201 charts were reviewed and 1142 subjects were eligible for inclusion. 640 patients had cervical spine fractures, and of these 158 patients had CTA/MRA. 24 were diagnosed with VAI, and 12 were treated for these findings. None of the subjects treated had complications from angiography, one patient with VAI had increased blood loss after initiation of therapeutic anticoagulation requiring transfusion. There has been a significant increase in CTA/MRA testing done ($P < 0.001$), but no significant increase in patients treated or in percent of positive tests ($P = 0.15$, $P = 0.77$).

CONCLUSION: Despite discussion at our institution of the clinical utility of CTA in the trauma population, there are more CTA studies being done and the number of patients diagnosed and treated for VAI have not changed. The presence of symptoms and risk of bleeding or other complications of therapeutic anticoagulation in this population are important factors to consider when ordering this test. We recommend the use of a treatment algorithm in the electronic ordering system to help aid practitioners in targeting the use of this test.

Gunshot Wounds to the Spine: How Successful is our Current Treatment Regimen?

Abstract ID: Paper 173

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Abstract:

INTRODUCTION: Spinal injuries due to a gunshot wound (GSW) are increasing in the civilian population, now the third leading cause of spinal injury. Fourteen percent of the annual 17,000 spinal cord injuries result from GSW. Patients with a spinal cord injury (SCI) due to a GSW have unique clinical concerns. Our study assessed the treatment of GSW to the spine at our institution over the last 10 years.

METHODS: A retrospective review of records from 2005-2015 identified patients as having a diagnosis of GSW to the spine. Information collected included demographics, spinal level of injury, neurological status, treatment (especially surgical vs. non surgical), organ perforation, and antibiotic coverage. Radiographs were reviewed for analysis of the exact bony injuries. Results were compared with a historical cohort from the same institution. Follow-up records were reviewed to assess for spinal infection and additional surgical treatment.

RESULTS: 256 patients met the criteria for GSW to the spine. This included 229 males and 27 females with a mean age of 29 years. Thoracic and lumbar vertebra had the highest rate of fracture: 75 cervical, 122 thoracic, 128 lumbar, and 39 sacral and coccyx. Of the 106 patients who had a neurological deficit, 48 had a complete deficit, 11 had an incomplete deficit, and 47 had a nerve root injury. 83 patients had gastrointestinal (GI) perforations. The distribution of GI injuries was as follows: 27 mouth, 5 pharynx, 1 esophagus, 13 stomach, 41 small intestine, 4 cecum, and 29 colon. 40 patients had both a GI and solid organ perforation. Of the solid organs, the following injuries resulted: 44 liver, 16 spleen, 48 lung, 6 heart, 34 kidney, 9 pancreas, and 4 urinary bladder. Only 27 of the 256 patients received surgical intervention for their spine. Of these, all received antibiotics during their hospitalization and none developed spine infections. Five patients who received surgical treatment for their spine injury and GI perforation did not develop a spine infection. The results were compared to published data from the previous decade.

CONCLUSION: The treatment for GSW to the spine has continued to improve over the past decade. The number of spine infections decreased dramatically with appropriate antibiotic care, especially in the population with GI tract injuries. Surgical intervention remained low among this patient population.

Need for Subsequent Fusion After High Risk Posterior Lumbar Decompressions

Abstract ID: Paper 174

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The risk of postoperative instability is thought to be high in patients with several consecutive spinal levels decompressed. Additional decompressions thought to be at high risk for subsequent instability include posterior decompressions adjacent to a fusion, and decompressions for spondylolisthesis. Traditional wisdom dictates that decompressions meeting one of these criteria should be coupled with fusion to prevent instability. We sought to investigate the subsequent fusion and reoperation rates of patients undergoing these “high risk” decompressions.

We retrospectively reviewed the charts of all lumbar spine surgeries performed over a 15-year period at a single Veterans Affairs hospital, and identified those who underwent multilevel (≥ 3) adjacent decompressions without fusion (M), decompressions adjacent to prior fusions (PF), decompressions adjacent to concomitant fusions (CF), and isolated decompressions for spondylolisthesis (S).

Records were reviewed to determine if any subsequent spinal operations were performed. We attempted to contact all patients by phone to inquire if they had received spine surgery outside our institution. If a patient was unable to be contacted, the follow-up time point was recorded as the last clinic visit with our department. Patients with less than 11 months of follow-up were excluded.

Seventy-seven patients met inclusion criteria. Of these patients, 56 were in group M, 9 were in group PF, 20 were in CF, and 7 were in S. Median follow-up time was 34 months (range 11-143).

Of the 77 patients, nine (12%) went on to subsequent arthrodesis. Of the arthrodeses, three were in group M (5% group total), two were in group PF (22% group total), two were in group CF (10% group total), and two were in group S (29% group total).

Our results show a low incidence of subsequent fusion after these “high risk” decompressions. The group undergoing three or more consecutive decompressions without fusion (group M) had the lowest rate of subsequent arthrodesis compared to the PF, CF, and S groups. These results suggest that the need for subsequent arthrodesis in decompressions of three or more consecutive levels without concomitant fusion may be less than dictated by conventional wisdom and broad clinical practice.

Comparison of Transforaminal Lumbar Interbody Fusion Outcomes in Patients Receiving rhBMP-2 vs. Autograft

Abstract ID: Paper 175

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BACKGROUND CONTEXT: Recombinant human bone morphogenetic protein 2 (rhBMP-2) plays a pivotal role in complex spine surgery. Despite its limited approval, the off-label use of rhBMP-2 is prevalent, particularly in transforaminal lumbar interbody fusions (TLIF).

PURPOSE: To determine the effectiveness and safety of rhBMP-2 use in TLIF procedures versus autograft.

METHODS: A retrospective study from 1997-2014 was conducted on 191 adults undergoing anterior-posterior instrumented spinal fusion with TLIF at a single academic institution. Patient data was gathered from operative notes, follow-up clinic notes, and imaging studies to determine complications and fusion rates. One hundred eighty-seven patients fit criteria, which included patients with a minimum of one TLIF, and had a minimum 2-year radiographic and clinical follow-up. Patients were further classified into a BMP group (n=83) or non-BMP group (n=104). Three logistic regression models were run using rhBMP-2 exposure as the independent variable. The respective outcome variables were TLIF-related complications (radiculitis, seroma, osteolysis, and ectopic bone), surgical complications, and all complications.

RESULTS: BMP (n=83) and non-BMP (n=104) groups had similar baseline demographics (sex, diabetes, pre-existing cancer). On average, the BMP and non-BMP groups were similarly aged (51.9 vs. 47.9 years, $p>0.05$), but the BMP group had a shorter follow-up time (3.03 vs. 4.06 years; $p<0.001$) and fewer smokers (8 vs. 21 patients; $p<0.048$). The fusion rate for the BMP and non-BMP groups was 92.7% and 92.3%, respectively. The pseudoarthrosis rate was 7.5% (14/187 patients). Radiculitis was observed in 7 patients in the BMP group (8.4%) and 2 patients in the non-BMP group (1.9%) in the non-BMP group. Seroma was observed in 2 patients in the BMP group (2.4%) and none in the non-BMP group. No deep infections were observed in the BMP group and 1 patient in the non-BMP group (0.96%). While patients exposed to BMP were at a significantly greater risk of developing radiculitis and seroma (OR=4.53, CI=1.42 – 14.5), BMP exposure was not a significant predictor of surgical complications (OR=0.32, CI=0.10 – 1.00) or overall complications (OR=1.11, CI=0.53 – 2.34). The outcome of TLIF-related complications was too rare and the confidence interval too wide for practical significance of the first model.

CONCLUSION: Evidence supports the hypothesis that off-label use of rhBMP-2 in TLIF procedures is relatively effective for achieving bone fusion at rates similar to patients receiving autograft. Patients exhibited similar complication rates between the two groups, with the BMP group exhibiting slightly higher rates of radiculitis and seroma.

MAOA BREAKOUT SESSION #13
KNEE ARTHROPLASTY
April 21, 2018

Overlapping Surgery in Primary Total Knee Arthroplasty: Are Outcomes Worse Than Single Operating Room Scheduling?

Abstract ID: Paper 176

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INTRODUCTION: Overlapping surgery is common in high-volume total knee arthroplasty (TKA) practices and has come under recent scrutiny in the lay press. The aim of this study was to evaluate differences in 1-year clinical and radiographic outcomes for primary TKA patients between single operating room (OR) and overlapping OR days.

METHODS: We retrospectively reviewed individual patient records of a consecutive series of primary TKAs with complete 1-year follow-up performed by a single academic orthopedic surgeon between 2010-2015 (N= 268). Patients were stratified by single OR vs. multiple overlapping ORs days. 98 patients (37%) had an overlapping surgery. Age, body mass index (BMI), Charlson Comorbidity Index (CCI) and American Society of Anesthesiologists (ASA) class were recorded to assess for confounding variables. Outcomes included anesthesia time, 30-day readmissions, return to OR, complication rates, patient reported outcomes (WOMAC pain, WOMAC functionality, and SF-36), 1-year radiographic coronal alignment, and periprosthetic radiolucencies or loosening.

RESULTS: There were no significant differences in anesthesiology time (165.5 vs. 164.5 min, $p = 0.85$), complication rates (9.5% vs. 5.1%, $p = 0.18$), 30-day readmissions (4.7% vs. 1.0%, $p = 0.16$), or return to OR (2.9% vs. 2.0%, $p = 1.00$), before and after adjusting for age, BMI, gender, ASA, and CCI. WOMAC pain (86.5 vs. 86.2, $p = 0.92$), WOMAC functionality (75.2 vs. 74.4, $p = 0.70$), and SF-36 scores (41.1 vs. 40.9, $p=0.93$) and were similar at 1 year. There were no differences in number of knees in neutral coronal alignment (94% vs. 89%, $p = 0.10$) or presence of radiolucencies on 1-year radiographs (6.5% vs. 6.1%, $p = 0.43$). In both groups, 2 of the 7 knees outside neutral coronal alignment were due to post-traumatic deformity. One knee outside of neutral alignment in the overlapping OR group was due to deformity following a failed infected high tibial osteotomy. There was one case of femoral aseptic loosening at 3 years in the single OR group.

DISCUSSION: This study demonstrates no differences in 1-year clinical or radiographic outcomes between patients undergoing primary TKA on single OR versus overlapping OR days, including patient-related outcome scores and radiographic outcomes. These results support the safe practice of overlapping surgical scheduling in primary TKA.

Tourniquetless Total Knee Arthroplasty with Modern Perioperative Protocols Decreases Pain and Opioid Consumption in Females

Abstract ID: Paper 177

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INTRODUCTION: This study examined whether a modern TKA protocol without a tourniquet results in less patient-reported pain and in-hospital opioid consumption compared to TKA with a tourniquet.

METHODS: A retrospective study of 203 primary unilateral cemented TKAs consecutively performed with or without tourniquet was performed. Identical perioperative pain and blood loss protocols were used in all cases. In tourniquetless TKAs, the tourniquet was not inflated at any time and sterile CO₂ gas compression maximized cement interdigitation.

RESULTS: After exclusions for scientific confounds, 184 TKAs (93 with tourniquet; 91 tourniquetless) were analyzed. Controlling for multiple covariates, females with a tourniquet reported significantly more pain ($p = 0.002$) and opioid consumption ($p < 0.001$) the first 24 hours following surgery compared to females without a tourniquet. There were no differences in pain ($p = 0.192$) or amount of opioids consumed ($p = 0.203$) among males with and without a tourniquet. Tourniquet use resulted in a significant reduction in blood loss for both females ($p \leq 0.040$) and males ($p \leq 0.020$), although the total blood savings of approximately 200 milliliters is of unknown clinical significance.

CONCLUSION: Avoiding tourniquet use during TKA for females may be a relatively risk-free adjunct to minimize opioid consumption during hospitalization. Further study is warranted to elucidate the factors accounting for different outcomes in females and males.

Keywords: total knee arthroplasty, tourniquet, tourniquetless, pain, opioids, blood loss

A Viable Alternative to Cemented Total Knee Arthroplasty: Clinical and Radiographic Outcomes of Cementless Total Knee Arthroplasty

Abstract ID: Paper 178

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PURPOSE: While cemented total knee arthroplasty (TKA) has long been the gold-standard for TKA, cementless TKA has been a highly sought after alternative. While many cementless designs have failed historically, many of the newer designs have performed remarkably well secondary to successful osteointegration with newer techniques, implants, and instrumentation methods. Failures of early implant designs often occurred at the tibial component and were attributed to inadequate fixation. The greatest migration for cementless tibial plate fixation occurs during the first 3 months. The purpose of this retrospective case series was to clinically document implant failure and radiographically evaluate the stability and early component migration of the implant.

METHODS: Medical charts and radiographs were assessed for patients who underwent cementless TKA at a single-institution. A total of 139 patients with mean age of 66 years were included in this analysis. Patients were clinically and radiographically assessed for implant failure. The Knee Society's Total Knee Arthroplasty Roentgenographic Evaluation was used to compare immediate postoperative radiographs with most recent radiographs for femoral flexion angle and tibial angle in the anterior-posterior and lateral knee radiographs. The total width of the radiolucent lines for each component was combined to generate a numeric score. Components were labeled with score of <8 as stable, 9-19 as closely observe, and >20 as loose.

RESULTS: More than 80% of patients had greater than 2-year follow up. There was a total of 3 implant failures. Two of these failures were from aseptic loosening, while one of these failures was traumatic. The tibial component and femoral component survival was 97.8% and 98.6%, respectively. For the anterior-posterior radiographs, the mean change in the femoral flexion angle and tibial angle was 1.07 degrees and 1.55 degrees, respectively. For the lateral radiographs, the mean change in the femoral flexion and tibial angle was 1.47 and 1.56 degrees, respectively. Excluding the implants that failed, 99.13% and 100% of the tibia and femoral component was classified as stable, respectively.

DISCUSSION: Cementless TKA is becoming an increasingly popular fixation option for patients with end-stage knee osteoarthritis. While previous studies have shown encouraging results with younger patients, this case series showed high implant survival rates in both younger and older patients. Concerns for early failure and migration of cementless TKA are over estimated. Cementless primary TKA appears to provide reliable fixation and is a viable alternative in primary TKA.

Mid- to Long-Term Follow-Up After Medial Unicompartmental Knee Arthroplasty in Patients Younger than 55 Years of Age

Abstract ID: Paper 179

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INTRODUCTION: While some surgeons tout unicompartmental knee arthroplasty (UKA) as the preferred option for younger patients, others have concerns about the durability of this option in a younger more active patient population. The purpose of this study is to describe the mid-term outcome results of UKA in patients under 55 years of age.

METHODS: Eighty-three medial UKA were performed in 46 men and 37 women with a mean age of 49 years old at the time of surgery (range, 33 to 55 years old). Patients were evaluated clinically using the Knee Society Score and radiographically for evidence of component loosening, wear related complications, and arthritic progression in the unresurfaced compartments. Continuous variables were compared using a paired t-test and survivorship was determined using the method of Kaplan and Meir.

RESULTS: At a mean of 7.1 years (range, 4.2 to 15.2 years) the mean preoperative Knee Society score improved from 61.2 to 81.5 points (range 40 to 100; $p < 0.0001$); 22 knees (54%) had a score of greater than 90 points. Mean range of motion was 124 degrees (range 90 to 140 degrees). Five knees (four patients) underwent revision to a total knee arthroplasty. Four patients (five knees; 6%) underwent revision to TKA at a mean of 45.8 months postoperatively. These included two revisions for unexplained pain at 9 months and 6.8 years, a bilateral revision for lateral compartment degeneration at 12 and 14 months and a revision for polyethylene wear at 9 years. 56 patients (67.5%) had arthritic progression to grade 1 or 2 in either the patellofemoral or lateral compartments and 13 patients (15.7%) had progression to grade 3 or 4 in either compartment. Estimated survivorship with failure for any reason was 89% at 15 years (95% CI: 71%-96%).

DISCUSSION AND CONCLUSION: UKA is a durable option for younger patients to treat unicompartmental arthritis with nearly 90% survivorship at 15 years.

Isolated Patellofemoral Joint Arthroplasty: Can Preoperative Bone Scans Predict Survivorship?

Abstract ID: Paper 180

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INTRODUCTION: Isolated patellofemoral joint (PFJ) arthritis has been identified in 10% of the population presenting with symptomatic knee osteoarthritis. The purpose of this study was to determine the results of PF arthroplasty in patients who had received a preoperative bone scans compared to those who had an MRI only.

METHODS: This is a retrospective review of 32 patients undergoing isolated PF arthroplasty for PF arthritis with the same implant. 16 consecutive patients received a preoperative bone scan for patient selection to confirm isolated PF arthritis. These patients were matched by age and gender with 16 patients where an MRI was used instead. There were 13 females and 3 males with an average age of 48 years (33-60) and a mean follow-up of 52 months (30-105 months) in the bone scan group. There was no significant difference in age, BMI, follow-up time, preoperative range of motion, or postoperative range of motion between the 2 groups. Clinical outcomes were evaluated including complications.

RESULTS: There were no revisions or implant related failures in the group with preoperative bone scans. Survivorship was 100%. Revision surgery was required in 5 out of 16 patients (31%) in those patients receiving only an MRI as a preop indications tool. The primary reason for revision in all patients was progression of arthritis in the tibial-femoral joint leading to TKA. There were no cases of implant related failures due to aseptic loosening or maltracking.

CONCLUSIONS: Patellofemoral arthroplasty using a current design implant demonstrated 100% survivorship when a preoperative bone scan was used for patient selection to confirm isolated PFA. In the group where only MRI was used, there was a 31% failure due to progression of disease. Based on this study, we would recommend the use of a bone scan for patient selection prior to isolated PF arthroplasty.

Unicompartmental Knee Arthroplasty Damage Modes and Chondrocyte Inflammatory Response

Abstract ID: Paper 181

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PURPOSE: Unicompartmental knee arthroplasty (UKA) has been developed for treating single-compartment osteoarthritis. However, increased rates of failure continue to be reported, due largely to polyethylene wear and progression of osteoarthritis into the adjacent compartment. The purpose of this study was to investigate the predominant damage and clinical failure modes in retrieved UKA systems, and the protein expression profile of inflammatory cytokines and tissue proteinases in articular cartilage adjacent to UKA systems as compared to primary osteoarthritic cartilage in vivo.

METHODS: Under an IRB-approved protocol, 50 retrieved UKA implants underwent microscopic evaluation for characterization of implant damage modes and associated radiographic review. In vivo tissue harvested from UKA revision and primary total knee arthroplasty (TKA) surgeries were characterized with a proteome profiling array detecting levels of 36 different cytokines, chemokines and acute phase inflammatory proteins. Retrospective chart review was performed to collect clinical medical record data and implant characteristics.

RESULTS: Progression of osteoarthritis (n=18, 36%) and component loosening (n=17, 34%) were the most common reasons for revision surgery. Tibial liners exhibited the highest frequency of all damage modes. Progression of arthritis positively correlated with radiographic presence of extruded bone cement (moderate), observed liner burnishing (weak), and observed condyle-extruded cement (weak). Proteomic profile between UKA and TKA cartilage yielded 12 significantly different cytokines.

CONCLUSION: Retrieval data suggest clinical failure of UKA relates with component wear and progression of cartilage degeneration into the adjacent femoral compartment. In vivo experiments indicate a potential role of wear debris induced cartilage degeneration in the adjacent compartments via a secondary mechanism to traditional osteoarthritic changes. Failure of UKA may be secondary to the introduction of wear debris particulate into the adjacent compartment, suggesting an additional pathway of cartilage failure, which manifests as traditional clinical symptoms.

Formal Physical Therapy May Not Be Essential Following Unicompartmental Knee Arthroplasty: A Randomized Clinical Trial

Abstract ID: Paper 182

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INTRODUCTION: Most surgeons and patients believe that formal physical therapy is required to achieve optimal outcomes. However, this notion has recently been challenged and the value of formal physical therapy has been questioned. The purpose of this randomized clinical trial was to determine whether formal outpatient physical therapy (PT) provided superior outcomes after unicompartmental knee arthroplasty (UKA).

METHODS: In this randomized clinical trial, 50 patients who had undergone UKA at two centers were randomized to 3 sessions per week of formal PT for 6 weeks or a 12-week self-directed exercise program. The primary outcome was range of motion (ROM) at 6 weeks with secondary outcome measures including the Knee Society Score (KSS), Knee Injury and Osteoarthritis Outcome Score (KOOS) Jr, Lower Extremity Functional Scale (LEFS), and Veterans Rands-12 Score (VR-12). Power analysis determined that 22 patients were required in each group to identify a 10° difference in ROM between groups with an alpha of 0.05 and beta of 0.90. The results were analyzed using a linear mixed model with patients as a random effect.

RESULTS: 25 Patients were randomized to each group. Preoperative patient characteristics were similar between treatment groups suggesting appropriate randomization. There was no difference in the postoperative ROM between the formal PT and self-directed groups (118° vs. 123° respectively; $p=0.35$). Similarly, there was no difference in the change in pre- to postoperative ROM between groups (6° vs. 4°; $p=0.5$). No significant differences were measured with the postoperative KSS (87 vs. 88), KOOS Jr (66 vs. 69), LEFS (47 vs. 51), and VR-12 (96 vs. 93) with the sample size studied ($p > 0.05$ for all comparisons).

CONCLUSIONS: Our results suggest that a self-directed exercise program has equivalent results when compared to a formal PT following UKA. The widespread implementation of such programs could lead to substantial cost savings.

Effect of Tibial Slope and Rotational Mismatch of the Tibial Cutting Guide on Coronal Plane Alignment in Total Knee Arthroplasty

Abstract ID: Paper 183

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PURPOSE: To determine the effect of rotational mismatch between the tibial component and the proximal tibial cutting guide with varying degrees of posterior slope on coronal plane alignment during total knee arthroplasty (TKA).

METHODS: Three-dimensional digital models of 15 cadaveric lower limbs were reconstructed using high definition computed tomography. Virtual distal femoral osteotomies were made perpendicular to the mechanical axis of the femur. Neutral and anatomic 3° varus proximal tibial osteotomies were made with respect to the mechanical axis of the tibia with varying degrees of slope and rotation of the virtual cutting guide. Osteotomies with 0°, 5°, and 10° of slope were made in 0°, 10°, and 20° of internal and external rotation with respect to the AP axis of the tibia. Coronal alignment was measured for each scenario.

RESULTS: At 0° tibial slope, the mechanical axis (MA) was unaffected by rotation of the cutting guide. Mean MA ranged from $3.79 \pm 0.86^\circ$ valgus alignment (neutral tibial osteotomy, 10° tibial slope, 20° internal rotation) to $6.07 \pm 0.88^\circ$ varus alignment (3° varus tibial osteotomy, 10° tibial slope, 20° external rotation). Average MA changes in linear fashion from valgus alignment to varus alignment as the tibial cutting guide rotation changes from internal to external rotation when a posterior slope is present. Keeping cut slope and rotational profile constant inter-specimen MA variation was up to 3.6°. Changing cut slope and rotational profile changed MA up to 13.1° between specimen.

A Systematic Review of Peri-Prosthetic Fractures After Total Knee Arthroplasty

Abstract ID: Paper 184

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INTRODUCTION: Peri-prosthetic fractures (PPF) following total knee arthroplasty (TKA) are on the rise. These complex injuries often require surgical intervention and are associated with high complications and poor functional outcomes. The purpose of this study is to perform a systematic review of the studies over the past 20 years. The aim is to determine any difference(s) in the outcomes with different treatments.

METHODS: 23 studies were included for final analysis. There were 3 broad treatment groups: intramedullary fixation, plate fixation, and revision arthroplasty. The outcomes and the complications were analyzed with respect to these different treatment protocols.

CONCLUSIONS: Complication rates among the 3 fixation methods were widely variable, We were unable to conclusively identify which treatment is the most optimal, as there are many clinical variables including fracture patterns, surgeon experience, and implant inventory. At minimum, this study further underscores the importance of conducting prospective, randomized, multi-center trials to obtain higher quality evidence on how best to treat PPFs after TKAs.

Patient Characteristics and Surgical Factors Associated with Early Reoperation Following Revision Total Knee Arthroplasty: A Case Control Study

Abstract ID: Paper 185

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INTRODUCTION: Revision total joint arthroplasty has higher rates of morbidity and mortality than primary total joint arthroplasty. Failed revision surgery may have additional 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 knee arthroplasty (TKA).

METHODS: We retrospectively reviewed the association between patient characteristics, surgical factors, and early reoperation following revision TKA using a matched case-control design. The source population included all patients at our institution who underwent revision TKA from 2005-2013. Case patients (n=93) were defined as those requiring reoperation within 1 year of revision TKA. Controls (n=149) were matched to cases 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. Stepwise multivariate logistic regression analyses with controlling for matching pairs' cluster effect were performed to identify risk factors for early reoperation. Variables with significance level of 0.05 were selected to enter and remain in the final model. With a reference proportion of reoperation of 12%, the power to detect an odds ratio of 0.2 was 0.8.

RESULTS: With the numbers available, peripheral vascular disease ($p=0.0305$) or renal insufficiency ($p=0.0305$) were risk factors for reoperation within 1 year of revision TKA. Unexpected positive intraoperative culture ($p=0.0500$) trended towards being predictive of early reoperation. The most common reasons for reoperation were infection (58%), followed by wound dehiscence (4%).

CONCLUSION: Our study suggests patients with history of peripheral vascular disease or renal insufficiency should be optimized preoperatively and closely monitored postoperatively the year following TKA revision surgery due to the increased risk of early reoperation. Utilization of a *Staphylococcus aureus* screening protocol, continuation of antibiotics until intraoperative cultures are final, and meticulous wound closure may minimize the risk of reoperation in these patients.

Patient Specific Instrumentation in Total Knee Arthroplasty Does Not Reduce Length of Stay, In-Hospital Complications or Discharge Disposition: A Propensity Score Matched Comparison

Abstract ID: Paper 186

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BACKGROUND: Total knee arthroplasty (TKA) is a quality surgical intervention for the management of degenerative knee conditions with rapidly increasing utilization in the United States. This growth has brought with it a host of new technologies, including patient specific instrumentation (PSI). With the current emphasis on value-based healthcare, the clinical benefit of technologies such as the PSI TKA must be thoroughly evaluated. The goal of this study is to compare PSI and conventional surgical techniques with respect to multiple quality metrics, length of stay, and discharge destination in patients undergoing elective TKA.

METHODS: A total of 972 unmatched conventional TKAs were compared to 231 consecutive PSI TKAs. Significant differences in preoperative demographics were noted. We then propensity score matched to 231 conventional TKAs to the 231 consecutive PSI TKAs. Propensity score matching controlled for age, gender, and BMI. All TKAs were performed at a single institution by fellowship trained arthroplasty surgeons. A standardized, protocolled approach to anesthesia, blood management, VTE prophylaxis, pain management, and physical therapy was followed for all patients. Preoperative risk factors analyzed included: age, gender, body mass index (BMI), preoperative hemoglobin, obstructive sleep apnea (OSA), asthma, and chronic obstructive pulmonary disease (COPD). Perioperative factors included: transfusion rate, hemoglobin drop, hemovac output, operative time, length of stay, discharge disposition, deep venous thrombosis (DVT) and pulmonary embolism (PE) rates, and in-hospital vital sign data.

RESULTS: Prior to propensity score matching, significant differences were noted in length of stay, transfusion rate, and operative time. However, when comparing matched groups, preoperative demographics were uniform. Both groups had a mean age of 68 years old, were 63% female, and had a BMI of 32. Preoperative hemoglobin was 12.4 and 12.3 g/dL in the conventional and PSI group, respectively. Postoperatively, there was no difference between conventional and PSI TKA in transfusion rate, operative time, length of stay, discharge disposition, and in hospital VTE rates. Discharge hemoglobin was 10.3 and 10.4 g/dL, and number of patients transfused was not significantly different ($p = 0.69$) in the conventional and PSI groups, respectively. Length of stay was 2.6 and 2.5 days ($p = 0.43$), and discharge disposition was 82% home and 83% home ($p = 0.90$), in the conventional and PSI groups, respectively.

CONCLUSION: Although PSI TKA is used more and more commonly, in our analysis it was not associated with any clinical difference in the immediate postoperative period as compared to TKA with conventional instrumentation.

13-15 Year Follow-Up of Fixed- vs. Mobile-Bearing Total Knee Arthroplasty: Does It Make a Difference? A Prospective Randomized Study

Abstract ID: Paper 187

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BACKGROUND: Fixed-bearing (FB) implants have a high rate of success in total knee arthroplasty. However, FB designs are at risk for subsurface delamination and wear from high contact stresses on the articular surface. Mobile-bearing (MB) implants have the theoretical benefit of more natural knee kinematics and decreased polyethylene wear, although have not shown superiority over FB designs. Previously, some of the authors showed no difference in the medium-term results of a randomized, controlled trial of FB versus MB implants. The purpose of this study is to report long-term results of this trial.

METHODS: Knee Society Score, Western Ontario MacMaster (WOMAC), and Short Form-36 (SF-36) were measured preoperatively and at multiple points after surgery. These scores were measured at an average of 13.5 years for this study. Failure was measured at either the time of death or revision. Of the original 72 FB and 68 RP prostheses, 28 patients died, and 45 patients were lost to follow-up, leaving 28 RP and 19 FB knees available for long-term review.

RESULTS: 69% were females in the FB group, and 57% in the MB group. Mean age was 64 years at the time of surgery for all patients. WOMAC scores showed no significant difference in pain ($p = .33$), stiffness ($p = .68$), or function ($p = .18$), and there were no differences for SF-36 nor the Knee Society Score ($p = .19$). There was no difference in the risk of mortality or failure (Hazard Ratio = 1.76, 95% CI: 0.80 – 3.87; $p = .16$).

CONCLUSIONS: At an average of 13.5 years, there were no significant differences in clinical outcome, mortality, or failure between FB and MB knee prostheses. There appears to be no long-term superiority of MB prostheses over FB, and their routine use is not supported.

Correlating Intraoperative Patellar Chondromalacia with Postoperative Anterior Knee Pain Following Total Knee Arthroplasty without Patellar Resurfacing

Abstract ID: Paper 188

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INTRODUCTION: Total knee arthroplasty (TKA) has become a remarkably successful surgery, but the variable decision to retain vs. resurface the articular surface of the patella remains controversial. Several studies have attempted to correlate the intraoperative status of the patellar cartilage with postoperative outcomes for unresurfaced patients; however, the data remains inconclusive. The current study aims to elucidate this controversy by correlating the intraoperative amount of exposed subchondral bone on the articular surface of the patella with patient reported rates of postoperative anterior knee pain, to determine if intraoperative assessment of the patellar cartilage may be a useful measure for surgeons making the controversial decision regarding patellar resurfacing during TKA.

METHODS: This is a prospective cohort study involving patients undergoing TKA without patellar resurfacing between 2011 and 2016 at a single academic institution. At the time of surgery, patients were consented to obtain intraoperative photographs of the articular surface of their patella. Attending physicians were blinded to patient information and asked to grade the degree of chondromalacia based on the amount of exposed subchondral bone visible in the intraoperative photographs. Individual scores were recorded for each of the four quadrants of the articular surface: superomedial, superolateral, inferomedial, and inferolateral. Patients at least 1 year removed from surgery were contacted by phone to attain their perceived rating of their current anterior knee pain using the previously validated Patellar Score survey. (Feller et. al, 1996). The callers were blinded to patient images as well as all personal identifiers to minimize observer bias. Upon completion of data collection, the correlation between patient reported anterior knee pain and the degree of intraoperative chondromalacia was determined using Spearman's rank-order correlation.

RESULTS: 96 patients were successfully contacted for this study representing a sample size of $n = 101$ patellas. The average age was 67.6 years with a mean time since surgery of 2.8 years. Two patients were necessarily excluded from the analysis for receiving revision patellar resurfacing following their initial surgeries. Statistical analysis revealed no correlation between intra-operative chondromalacia and patient reported Patellar Score with regards to the superomedial quadrant, inferomedial quadrant, superolateral quadrant, inferolateral quadrant, as well as the overall surface average (Spearman's rho, $r = -0.002, -0.07, -0.142, -0.075, \text{ and } -0.097$, respectively).

CONCLUSION: The degree and location of exposed subchondral bone on the articular surface of the patella did not correlate with patient reported anterior knee pain at a mean follow-up of

2.8 years in patients who underwent TKA without patellar resurfacing. Thus, the severity of intraoperative chondromalacia may be ineffective as an indication for resurfacing.

Experience Influences the Agreement and Reliability of Tibial Component Positioning in Total Knee Arthroplasty

Abstract ID: Paper 189

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INTRODUCTION: Poor rotation of the tibial component is associated with unfavorable total knee arthroplasty (TKA) results. Some surgeons utilize the tibial tubercle while others utilize the femoral cam (Box method) as a rotational landmark during TKA. No standard method for assessing tibial component rotation exists. Our purpose was to determine the reproducibility of two methods for establishing intraoperative tibial component rotation, while also comparing the effect of level of training.

MATERIALS AND METHODS: Twelve surgeons (3 junior residents, 3 senior residents, 1 fellow, 3 fellowship-trained arthroplasty surgeons, and 2 Knee Society members) positioned and sized a symmetric tibial component on 7 cadaver knees. Each surgeon was allowed to utilize their preferred method for establishing tibial component rotation. Seven surgeons selected the TT method, 4 utilized the Box method, and 1 used both methods depending on the specimen. Repeat measurements were completed by each surgeon after a 15 minute rest period. The differences between tibial tray positions were assessed using 3D computer-assisted optoelectronic measurements. Intra-class correlation coefficients were calculated to determine inter-observer agreement and intra-rater reliability.

RESULTS: The overall IRR was 0.94, but the IOA was 0.72. The Box method (IRR 0.98) was more reproducible than the TT method (IRR 0.80). Experience influenced reproducibility of tibial component rotation. Knee Society members were more consistent (IOA 0.91) than senior residents (IOA 0.82). Senior residents were more consistent (IOA 0.73) than junior residents (IOA 0.58). The Box method was more consistent for trainees of any level (IOA 0.94) when compared to the TT method (IOA 0.54).

DISCUSSION: Surgeon experience influenced the agreement and reliability of tibial component position. For less experienced surgeons, the box method was more effective than the tibial tubercle method for reproducing tibial component rotation. The femoral cam may be more reproducible than using the tibial tubercle, particularly for trainees.

What is the Impact of Smoking on Revision Total Knee Arthroplasty?

Abstract ID: Paper 190

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INTRODUCTION: Recent studies have begun to demonstrate an association between smoking and increased complications following primary total knee arthroplasty (TKA). However, there is a paucity of literature evaluating the impact of smoking on revision arthroplasty procedures. Given the increasing frequency of revision TKA surgery and the higher rate of complications that are associated with these procedures, it is important to understand impact of modifiable risk factors on revision TKA outcomes. Therefore, the purpose of this study was identify the effect of smoking on complications after revision TKA.

METHODS: We queried the American College of Surgeons National Surgical Quality Improvement Program (ASC NSQIP) database to identify patients who underwent revision TKA between 2006 and 2014. Patients were divided into current smokers and nonsmokers according to ASC NSQIP definitions. Each cohort was compared in terms of demographic data, preoperative comorbidities, and operative time. Multivariate logistic regression analysis was utilized to adjust for confounding variables and calculate adjusted odds ratios (OR) and associated 95% confidence intervals (95% CI) for the outcomes of any wound complication, deep infection and reoperation within 30-days of revision TKA.

RESULTS: In total, 8,776 patients had undergone a revision TKA procedure. Of these patients, 11.6% were current smokers and 88.4% were nonsmokers. Univariate analyses demonstrated that smokers had a higher rate of any wound complication (3.8% vs. 1.8%, $p < 0.001$), deep infection (1.5% vs. 0.5%, $p < 0.001$), pneumonia (1.3% vs. 0.4%, $p < 0.001$) and reoperation (5.0% vs. 3.1%, $p = 0.001$) compared to nonsmokers undergoing revision TKA. Multivariate analysis controlling for confounding demographic, comorbidity and operative variables identified current smokers as being at a significantly increased risk of any wound complication (OR 2.1; 95% CI 1.4-3.2), deep infection (OR 2.1, 95% CI 1.2-3.6), and reoperation (OR 1.5, 95% CI 1.02-2.1) after revision TKA.

CONCLUSION: This study demonstrates that smoking significantly increases the risk of infection, wound complications, and reoperation after revision TKA. The impact of smoking on wound complications and infection appears to be even more magnified for revision procedures compared to published effects of smoking on primary TKA complications. Given that revision TKA surgery intrinsically carries an increased risk of postoperative complications relative to primary procedures, it is even more important to understand the impact of modifiable risk factors, such as smoking, on postoperative complications in order to optimize outcomes. Further research is needed regarding the impact of smoking cessation on mitigation of these observed risk.

Can the Infrapatellar Branch of the Saphenous Nerve Be Preserved Using the Standard Midline Surgical Approach for Total Knee Arthroplasty: A Cadaver Study

Abstract ID: Paper 191

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INTRODUCTION: The infrapatellar branch of the saphenous nerve (IPBSN) is a purely sensory nerve innervating the anteromedial aspect of the knee and anteroinferior knee joint capsule. Total knee arthroplasty (TKA) is commonly used to treat end-stage arthritis, but the IPBSN is often injured and results in numbness around the anteromedial aspect of knee. The aim of this cadaveric study was to describe the course and variability of the IPBSN and to assess whether it is possible to preserve it during a standard midline surgical approach in TKA.

METHODS: Ten fresh-frozen cadaver legs were dissected using a midline approach to the knee. Skin and subcutaneous flap were reflected to expose both the saphenous nerve and its branches. The branches of the IPBSN were identified, and their vertical distances above the tibial tuberosity (TB) were recorded: TB to inferior branch, to middle branch, and to superior branch.

RESULTS: There were 10 left-sided specimens (6 female, 4 male) with a mean age of 79.9 ± 9.8 years. 8 (80%) specimens had 2 branches of IPBSN while 2 (20%) specimens had 3 branches. The average distance from TB to the inferior branch was 16.8 ± 8.3 mm (3.0-28.0 mm); middle branch, 24.0 ± 1.4 mm (23.0-24.9 mm); and superior, 45.9 ± 7.7 mm (32.0-54.5 mm).

CONCLUSION: Our cadaveric study found no plausible method for preserving the IPBSN using a standard midline approach in TKA. It is important to provide proper patient education on this complication, and surgeons should be aware of approximate locations and variation of IPBSN while performing other surgeries about the knee.

Hyaluronic Acid Injections of the Knee: Predictors of Successful Treatment

Abstract ID: Paper 192

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BACKGROUND: Knee viscosupplementation yields variable results for osteoarthritis. Orthopedic societies vary in their recommendations regarding its use. Identifying patient and treatment factors that predict a favorable response to intra-articular hyaluronic acid (HA) treatment will better guide patient and treatment selection.

METHODS: This prospective, observational study evaluated patients with mild to moderate (Kellgren-Lawrence grades 1-3) primary knee osteoarthritis from March 2013 to May 2016. Patient function and pain scores were assessed by WOMAC/KOOS and VAS surveys, with response to treatment defined according to the OARSI 2004 criteria. Surveys were completed at each injection and 3 months post-treatment. Patients were followed an average of 27 months.

RESULTS: We enrolled 128 patients, 102 were analyzed; 57% had a positive response to treatment. Patients with grades 1-2 osteoarthritis were 2.2 times more likely to respond positively than grade 3 ($p=0.001$). Patients with a positive response to the first injection were 2.3 times more likely to respond positively at completion ($p=0.001$). Those ≥ 60 years with grade 2 osteoarthritis were 2 times more likely to respond positively than those < 60 years ($p=0.009$). Gender, race, BMI, smoking status, HA brand, and initial VAS and WOMAC/KOOS scores were not significant predictors of success. Mean time to arthroplasty following injection series was 11 months, with 30% of non-responders, compared to 12% of responders, proceeding to arthroplasty ($p=0.028$). The VAS strongly correlated with KOOS pain scores and successful outcomes.

CONCLUSION: Patients with mild to moderate osteoarthritis (grades 1-2) and those responding positively to the first injection were twice as likely to respond positively to the injection series. Patients ≥ 60 years were twice as likely to respond positively for grade 2 osteoarthritis. Patients who did not respond positively were more likely to proceed to arthroplasty. The VAS appears to be a reliable method of defining and monitoring treatment success. Judicious patient selection and counseling may improve outcomes associated with intra-articular HA injections.

Keywords: osteoarthritis; knee; hyaluronic acid; injection; viscosupplementation

Level of Evidence: Level II, Therapeutic

Development and Evaluation of a Calculator for Success of Treatment of Periprosthetic Joint Infection

Abstract ID: Paper 193

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BACKGROUND: Preoperative identification of patients at risk of failing treatment for periprosthetic joint infection (PJI) is imperative to allow medical optimization and targeted prevention. The purpose of this study was to create a preoperative risk calculator for PJI treatment failure by assessing a patient's individual risk for treatment failure based on many pre-operative variables.

METHODS: A retrospective review was performed of 1,438 PJIs, treated at two institutions from 2000 to 2014. Minimum follow-up was 1 year. A total of 77 risk factors, including patient characteristics, microbiology data, and surgical variables were evaluated with a multivariate analysis, in which coefficients were scaled to produce integer scores.

RESULTS: In descending order of relative weight, the ten significant risk factors for PJI treatment failure were: irrigation and debridement (159 patients), body mass index (138 patients per BMI), one stage exchange arthroplasty (88 patients), liver disease (52 patients), cardiovascular event (51 patients), bipolar disorder (49 patients), revision surgery (34 patients), smoking (22 patients), knee joint involvement (20 patients), and number of prior operations (7.1 patients per prior operation). The area under the curve (AUC) for this risk model was 0.666 (95% CI: 0.635-0.698). When taking into account organism type and serological and aspiration results, a sinus tract, infection with resistant organisms (MRSA and VRE), and synovial white cell count were also significant risk factors for treatment failure of PJI (AUC: 0.6904, 95% CI: 0.6476 - 0.7331).

DISCUSSION: In this large cohort study, we were able to identify risk factors and their relative weight for predicting PJI treatment failure. Some of the identified factors are indeed modifiable and should be addressed prior to treating a patient for PJI.

Infected Unicompartmental Knee Arthroplasty: A Surprisingly High Prevalence of Subsequent Complications

Abstract ID: Paper 194

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INTRODUCTION: Little literature exists regarding the treatment or outcome of periprosthetic joint infection (PJI) following unicompartmental knee arthroplasty (UKA). Our purpose is to report implant survivorship, complications, and clinical outcomes after surgical treatment of UKA PJIs.

METHODS: We identified 18 UKA PJIs between 1992 and 2016. The mean age at PJI diagnosis was 58 years, 56% male, mean BMI of 30 kg/m². Eleven patients satisfied major Musculoskeletal Infection Society (MSIS) diagnostic criteria. Eight (44%) of patients were MSSA positive and 6 (33%) were positive for coagulase negative staphylococcus. Using MSIS criteria, there were 8 (44%) acute postoperative infections, 6 (33%) acute hematogenous infections, and 4 (22%) chronic PJIs. Two-stage exchange was performed by removing all components, completing femoral and tibial cuts for subsequent TKA, and placing a static antibiotic spacer. Irrigation & debridement procedures were typically single-stage and included liner exchange. Mean follow-up was 3 years.

RESULTS: Survivorship free of reinfection after UKA PJI treatment was 70% at 5 years and was distinctly different for 2-stage (100% at 5 years) versus I&D (58% at 5 years). Five of 13 patients (38%) undergoing I&D were re-infected at final follow-up. Survivorship free of any revision was 53% at 5 years. Two patients from 2-stage group underwent femoral component revision for aseptic loosening at mean 7 years, and 2 from I&D group were converted to TKA for disease progression at mean 4 years. Mean KSS improved from 71 to 83 (p=0.1).

CONCLUSIONS: Treatment of UKA PJI was associated with a high prevalence of subsequent complications. Two-stage exchange predictably led to infection control, but late femoral component loosening was noted. I&D with liner exchange frequently resulted in reinfection or progression of arthritis requiring conversion to TKA.

Total Knee Arthroplasty Megaprosthesis in Non-Tumor Patients - Are Septic Indications Worth the Effort?

Abstract ID: Paper 195

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INTRODUCTION: The use of a megaprosthesis in primary and revision total knee arthroplasty (TKA) are used for the management of catastrophic fractures and severe bone deficiency involving the distal femur including replants after severe infections. These procedures are often considered limb salvage and are an alternative to an amputation. The purpose of this study was to evaluate the short-term postoperative outcomes following the use of a distal femoral replacement (DFR) in non-tumor patients undergoing TKA and establish if septic revisions have a higher failure rate.

METHODOLOGY: Patients who underwent a (DFR) for non-tumor indications between 2008 and 2015 were retrospectively reviewed (n=140). The cohort was stratified into primary surgery (i.e., catastrophic distal femur fracture), aseptic revision (i.e., aseptic implant loosening, periprosthetic fracture), and septic revision (i.e., previous prosthetic joint infection) based on surgical indication, as well as patients who developed a deep postoperative infection versus those who did not. There were a total of 22 (16%) primary surgeries, 63 (45%) aseptic revisions, and 55 (39%) septic revisions. Measured outcomes included post-surgical complications within 90 days postoperative including hospital lengths of stay (LOS), readmissions, and mechanical and non-mechanical causes of failure including infection. Outcomes were assessed with a univariate analysis using Chi-square or Fisher exact tests. A p-value of less than 0.05 was used to determine statistical significance.

RESULTS: Of the septic revision group, 24 (44%) became re-infected requiring a revision surgery compared to 9 (14%) and 3 (14%) in the aseptic and primary groups, ($p<0.0001$). In addition, there were significant differences in age ($p=0.022$), gender ($p=0.04$), LOS ($p=0.05$), nonsurgical complications ($p=0.007$), and readmissions at both 30 days ($p=0.006$) and 90 days postoperatively ($p=0.009$). Compared to those who did not become infected, infected patients had longer hospital LOS ($p<0.001$), had greater mean Charlson scores ($p=0.125$), experienced more non-surgical comorbidity related complications ($p<0.0001$), were readmitted more often ($p<0.001$), and experienced more failures of periprosthetic fractures, extensor mechanism failures, and amputations ($p<0.05$ for all).

CONCLUSION: The use of megaprosthesis as a 2nd stage revision for prosthetic joint infection in TKA is associated with high short-term postoperative complications compared to use with aseptic revisions. These complications are most commonly due to a re-infection. Surgeons should be extremely cautious using these implants for reimplantation given the high re-infection

rate. These results provide valuable information that may be used to help counsel patients on postoperative expectations after DFR including discussions about amputation over TKA.

Utility of Serological Markers for Detecting Persistent Infection in Two Stage Revision Arthroplasty in Patients with Inflammatory Arthritis

Abstract ID: Paper 196

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BACKGROUND: Serum erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are commonly used tests for the diagnosis of persistence of infection during two-stage revision arthroplasty for periprosthetic joint infection (PJI). As both ESR and CRP are markers of systemic inflammation, the utility of these tests to monitor infection eradication in patients with inflammatory arthritis is unclear. The objectives of this study were to: (1) compare the serum ESR and CRP values between the first and planned second stages; and (2) determine the diagnostic utility of ESR and CRP to detect persistence of infection in patients with inflammatory arthritis.

METHODS: From 2001-2016, all two-stage revision hip or knee arthroplasties performed at a single institution were retrospectively identified. Revisions were included if they were performed in patients with an inflammatory arthritis diagnosed by a rheumatologist and had all the tests required to fulfill MSIS criteria for PJI at the time of second stage. Persistent infection was defined as positive MSIS criteria (applied retrospectively) at the time of planned second stage. 44 revisions met the inclusion criteria and were included in the analysis. Receiver operating characteristic curve analysis was performed to obtain the diagnostic parameters.

RESULTS: Mean ESR (54.9 vs. 30.9, $p<0.001$) and CRP (6.1 vs. 2.1, $p<0.001$) decreased between the stages. 14 (31.8%) revisions were found to have a persistent infection. ESR and CRP at the time of second stage were higher in the persistent infection group (ESR=51.2 vs. 21.5, $p=0.011$; CRP= 4.1 vs. 1.1, $p=0.001$). Optimal thresholds for persistent infection were 29.5 mm/hr and 2.8 mg/dl, respectively for ESR and CRP. Sensitivity and specificity at the optimal thresholds were 64% and 77% for ESR, and 64% and 90% for CRP. Both ESR and CRP had similar diagnostic performance ($p=0.342$).

DISCUSSION: Both ESR and CRP responded to the treatment of PJI in patients with inflammatory arthritis and had reasonably high specificities with moderate sensitivities. The results of our study suggest that persistently elevated serological markers may indicate ongoing infection and should not be presumed to be from the underlying inflammatory arthritis. ESR and CRP are useful tools in diagnosing persistent infection and are recommended for monitoring infection clearance even in patients with inflammatory arthritis.

MAOA BREAKOUT SESSION #14
SHOULDER ARTHROPLASTY
April 21, 2018

Identifying Appropriate Candidates for Outpatient Shoulder Arthroplasty: A Validated Selection Algorithm

Abstract ID: Paper 197

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INTRODUCTION: Total shoulder arthroplasty (TSA) is a reliable surgical procedure used to treat glenohumeral arthritis, and is increasing in frequency due to a number of factors. Studies have shown that TSA can be performed safely on an outpatient basis, but selecting appropriate outpatient candidates remains challenging. In this study we propose an algorithm for selecting outpatient TSA candidates with validation by a cohort of patients from our ambulatory surgery center experience.

METHODS AND MATERIALS: A cohort of patients who underwent primary total shoulder arthroplasty, both anatomic and reverse, were identified. Patients were identified using our selection algorithm, which stratifies patients referable to their age and cardiopulmonary comorbidities. This selection algorithm was managed by the treating surgeon and anesthesiologist. A total of 61 shoulders were included, composed of 49 anatomic total shoulder arthroplasties, and 12 reverse total shoulder arthroplasties (RTSA). Documented acute blood loss anemia, transfusion, wound complications, hospital admission, and reoperation were considered to be acute surgical complications. Non-surgical/cardiopulmonary complications were defined as mortality, arrhythmia, blood pressure volatility, syncope, thromboembolic events, pneumonia, renal failure, any other substantial deviation from the typical postoperative course not attributable to the direct effects of surgery.

RESULTS: The cohort was 64% male (39), with an average BMI of 31 (21-49), and an average age of 58 years (37-69). All 61 patients were discharged from the surgery center on the day of surgery. Overall, there were no cardiopulmonary events requiring intervention or hospital admission and one patient (2%) required a secondary operation. A total of 3 patients (5%) experienced acute surgical complications. One patient (2%) had continued bleeding in the recovery area that resolved with compression, but later required evacuation of hematoma. Non-surgical complications included a patient that experienced acute postoperative bradycardia that resolved, as well as a patient who became acutely hypotensive with induction of anesthesia. Three patients (5%) experienced transient postoperative nausea, and four patients (7%) sustained additional complications within the 90-day episode of care.

CONCLUSION: This study is the first to identify a patient selection method for outpatient total shoulder arthroplasty. Use of this algorithm produced a low rate of perioperative complications and no hospital admissions. We suggest this algorithm provides a method for the

standardization of outpatient TSA candidate selection, aiding physicians seeking an evidence-based method of evaluation for patients interested in TSA in the ambulatory setting.

Restoration of External Rotation After Reverse Shoulder Arthroplasty without Latissimus Dorsi Transfer

Abstract ID: Paper 198

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INTRODUCTION: For patients with a preoperative external rotation (ER) deficit, latissimus dorsi transfers have been thought necessary to restore active ER following reverse shoulder arthroplasty (RSA). The purpose of this study was to assess the effectiveness of a RSA system that lateralizes the center of rotation (COR) in restoring active ER without the use of latissimus dorsi transfer in a subset of patients with a preoperative ER deficit ($ER < 0^\circ$).

METHODS: A retrospective review was performed for patients who underwent RSA with a lateralized COR, had ≥ 2 -year follow-up, preoperative active $ER < 0^\circ$, and did not undergo latissimus dorsi transfer. Patients were stratified into those with combined loss of elevation and external rotation (CLEER) and those with preoperative $ER < 0^\circ$ due to other etiologies (non-CLEER). Mean ER improvement was analyzed. Subgroup analysis was performed based on Goutallier classification (determined using preoperative CT imaging), glenosphere lateralization (based on prosthetic design), and total prosthetic lateralization (determined by combining glenosphere lateralization, humeral augment lateralization, and the variable thicknesses of the polyethylene components based on the manufacturer's information).

RESULTS: 33 patients met inclusion criteria (24 CLEER and 9 non-CLEER). Average follow-up was 43.4 months (range 24-77). Significant improvement was observed in ER for both the CLEER group (mean -21° preoperatively to 28° postoperatively, $p < 0.001$) and the non-CLEER group (mean -19° preoperatively to 26° postoperatively, $p = 0.001$). Goutallier classification, glenosphere lateralization, or total prosthetic lateralization was not correlated with degree of ER improvement ($p > 0.05$ for all) in either group. Multivariate regression analysis of age, preoperative ER, infraspinatus Goutallier grade, teres minor Goutallier grade, glenosphere lateralization, and total prosthetic lateralization showed no significant predictors of ER improvement in patients with CLEER ($p = 0.963$) and non-CLEER ($p = 0.753$). Overall postoperative patient satisfaction was 93.9%.

CONCLUSIONS: In patients with a preoperative ER deficit due to CLEER or other etiologies, RSA with a lateralized COR can effectively restore ER without the use of latissimus dorsi transfer.

Disability Claims Predict Markedly Worse Outcomes Following Shoulder Arthroplasty

Abstract ID: Paper 199

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BACKGROUND: Shoulder arthroplasty (anatomic and reverse) has been shown to be an effective treatment for a myriad of shoulder pathologies. Determining factors that affect outcomes is increasingly important as focus shifts to bundled payment care initiatives and pay for performance. We proposed to determine the effect of disability status on clinical outcomes in patients undergoing shoulder arthroplasty.

METHODS: A retrospective review of our institutional database returned 133 shoulders with at least 2 years of clinical follow-up (average 30.4 months, range 24 -71). Patients were divided into non-disabled (113 shoulders) and disabled (20 shoulders) groups based on the presence of Supplemental Security Income disability claims. None of the patients were disabled due to their shoulder condition. There were 71 anatomic total shoulders (8 disabled, 63 non-disabled) and 62 reverse total shoulders (12 disabled, 50 non-disabled). Preoperative and postoperative outcome measures were compared between the two groups. Outcome measures were the American Shoulder and Elbow Surgeons Shoulder Score (ASES), visual analog pain scale (VAS), range of motion, and strength in forward elevation, external, and internal rotation.

RESULTS: There were no significant differences in the proportion of anatomic and reverse arthroplasties between disabled and non-disabled groups. The non-disabled group had significantly higher postoperative ASES score (78.2 vs. 47.3, $p = 0.001$), lower VAS (1.4 vs. 5.4, $p = 0.001$), greater range of motion in forward elevation (141 vs. 109 degrees, $p = 0.001$) and internal rotation (53 vs. 44 degrees, $p = 0.028$), and greater strength in forward elevation (4.8 vs. 3.9, $p = 0.001$), external (4.9 vs. 4.2, $p = 0.001$) and internal rotation (4.9 vs. 4.3, $p = 0.001$) than the disabled group. The non-disabled group also had greater increase in ASES score (37.1 vs. 22.3, $p = 0.012$) and greater decrease in VAS (-3.8 vs. -2.2, $p = 0.039$) from preoperative to postoperative than the disabled group. The complication rate was also doubled in the disabled group (30% vs. 15%), though this did not reach statistical significance. There were no differences between groups regarding re-operation or re-admission rates.

CONCLUSION: Disability status has a significant adverse effect on outcomes in patients undergoing shoulder arthroplasty. While outcomes in terms of functional scores and pain relief are inferior, the degree of improvement is also much less in patients with disability claims. This information is important when counseling patients on disability and is highly relevant in the evolution of outcomes-based payment models.

Does the Second Shoulder Arthroplasty Outperform the First? Comparative Outcomes of Bilateral Shoulder Arthroplasty

Abstract ID: Paper 200

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INTRODUCTION: Bilateral total knee arthroplasty studies have reported differences in outcomes between the first and second operated knees; however, studies reporting outcomes following staged bilateral shoulder arthroplasty (BSA) are limited. The purpose of this study was to compare the overall improvement between first and second operated shoulders following BSA.

METHODS: Pre- and postoperative function (Simple Shoulder Test [SST], American Shoulder and Elbow Surgeons [ASES], Visual Analogue Scale [VAS] function, Single Assessment Numerical Evaluation [SANE]), VAS pain, general health (physical and mental component summary [PCS/MCS] of 12-Item Short Form Survey [SF-12]), and measured motion were assessed for patients who underwent BSA with 2-year follow up. Efficacy of treatment was defined as pre- to postoperative improvement in outcomes. Ultimate postoperative outcomes and efficacy of treatment were compared for first and second operated shoulders.

RESULTS: Seventy-three patients (146 shoulders) met inclusion criteria with a mean follow-up of 51.4 months (range 24-118 months). Anatomic total shoulder arthroplasty (TSA) made up 71.2% (n=52) of the first surgeries while 28.8% (n=21) were reverse shoulder arthroplasty (RSA). The second surgery was 69.9% (n=51) TSA and 30.1% (n=22) RSA. The average time between first and second surgeries was 21.1 months (range 2.1-64.7 months). There were no significant differences between first and second operated shoulders for all pre- and postoperative variables except for preoperative PCS which was greater in the second shoulder (38 ± 9 vs. 33 ± 8 , $p=0.005$). Overall efficacy of treatment was not significantly different between first and second surgeries except for PCS (13 ± 10 in the first shoulder vs. 5 ± 11 in the second shoulder, $p=0.001$) and forward elevation ($56 \pm 28^\circ$ in the first shoulder vs. $41 \pm 41^\circ$ in the second shoulder, $p=0.01$).

CONCLUSIONS: Improvements in function, pain, and motion were similar between the first and second shoulder arthroplasty surgeries. However, improvements in perceived physical well-being increased to a greater extent after the first surgery, likely due to patients having significantly lower Physical Component Summary (SF-12) prior to the first shoulder surgery. A greater degree of postoperative improvement in forward elevation was also seen after the first shoulder arthroplasty when compared to the second, but this difference was not likely clinically significant.

Association of Percent of Maximal SST and ASES Improvement with Excellent Patient Satisfaction Following Shoulder Arthroplasty

Abstract ID: Paper 201

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INTRODUCTION: Defining 'better' outcomes as improvement greater than 30% of maximal possible improvement in Simple Shoulder Test (SST) score has been thought to limit ceiling effects and set a higher standard for the measurement of clinically significant improvement after shoulder arthroplasty. No study to our knowledge has linked the percent of maximal improvement in functional outcome scores to patient satisfaction. The purpose of this study is to determine whether certain thresholds exist for predicting 'Excellent' patient satisfaction following shoulder arthroplasty using improvements in the percent of maximal SST or American Shoulder and Elbow Surgeons score (ASES).

METHODS: A retrospective analysis was performed for patients undergoing shoulder arthroplasty (anatomic, reverse, or hemiarthroplasty) since 2007 with minimum 2-year follow-up. Pre- and postoperative SST and ASES scores are recorded as part of our shoulder registry protocol and postoperative patient satisfaction is reported as 'Excellent', 'Good', 'Satisfactory', or 'Unsatisfactory'. Patients were stratified based on percent of maximal improvement achieved in SST or ASES scores. The percentages of patients in each group reporting "Excellent" satisfaction were compared.

RESULTS: 354 patients had at least 2-year follow-up for SST (mean follow-up 42.3 months, range 24-112). 245 patients (69.2%) reported "Excellent" satisfaction. Patients achieving >60% of maximal SST improvement had higher rates of reporting "Excellent" satisfaction (85.2%) than those achieving 31-60% maximal SST improvement ($p<0.001$). Patients achieving 31-60% maximal SST improvement had higher rates of "Excellent" satisfaction (62.0%) compared to patients with <30% maximal SST improvement ($p<0.001$). For all patients with postoperative SST improvement (328 patients), there was a positive correlation between percent of maximum ASES achieved and "Excellent" satisfaction ($r=0.444$, $p<0.001$).

482 patients had at least 2-year follow-up for ASES (mean follow-up 48.3 months, range 24-124). 349 patients (72.4%) reported "Excellent" postoperative satisfaction. For all patients with postoperative ASES improvement (446 patients), there was a positive correlation between percent of maximum ASES achieved and "Excellent" satisfaction ($r=0.470$, $p<0.001$).

CONCLUSIONS: Two thresholds for predicting "Excellent" satisfaction were identified at 30% and 60% of maximal SST improvement. Patients achieving 60% of maximal SST improvement can expect an 85% chance of achieving 'Excellent' satisfaction. The percent of patients with "Excellent" satisfaction increased in a linear fashion as percent of maximal improvement achieved in ASES increased. Moderate correlations exist between the percent of maximal SST

and ASES improvement achieved and “Excellent” satisfaction, suggesting that continued improvement in both SST and ASES result in higher rates of 'Excellent' satisfaction.

The Impact of Insurance Status on the Clinical Outcomes After Shoulder Arthroplasty

Abstract ID: Paper 202

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INTRODUCTION: Shoulder arthroplasty is an effective treatment option for patients with symptomatic shoulder arthritis and rotator cuff arthropathy. While there have been reports of complication rates varying according to insurance, studies examining the impact of payer status on functional outcomes in patients who have undergone shoulder arthroplasty is lacking.

METHODS: Patients underwent elective shoulder arthroplasty by a single fellowship-trained surgeon and had a minimum of one year follow-up were queried. Patient characteristics were compared across insurance types. Each patient completed a preoperative and postoperative American Shoulder and Elbow (ASES) form. A generalized linear mixed model was specified to predict ASES score at one year and included preoperative ASES score as an adjustment variable.

RESULTS: 84 patients underwent 91 procedures. Prior to operation, ASES score differed by insurance ($p=0.014$), driven by lower scores among Medicaid patients compared to those with private insurance (mean [SD]: 20.4 (4.5) versus 38.8 [3.9], $p=0.009$). After controlling for baseline ASES, postoperative ASES at the one year follow-up differed by insurance type as well ($p<0.001$). Patients with private insurance had better ASES scores (mean [SD]: 85.6 [4.6]) compared to those with Medicaid (55.2 [5.4], $p<0.001$) and Worker's Compensation (57.1 (8.5), $p=0.028$). Patients with Medicare (80.6 [2.8]) also had better ASES scores at follow-up compared to Medicaid ($p<0.001$). Preoperative Visual Analogy Scale (VAS) scores did not significantly differ by insurance type ($p=0.18$). Postoperative VAS scores significantly differed by insurance, however ($p<0.001$), with those with Medicaid (mean [SD]: 4.31 [0.64]) having significantly higher VAS scores compared to both private (1.05 [0.55], $p<0.001$) and Medicare insurance (1.23 [0.34], $p<0.001$). Rates of reoperation did not differ significantly among insurance types ($p=0.82$).

CONCLUSIONS: Medicaid patients are at risk for significantly lower postoperative functional outcome scores after shoulder arthroplasty when compared to patients with private insurance and Medicare. Medicaid patients in this cohort had lower preoperative ASES scores compared to other groups, despite there being no difference in VAS scores across all payor groups. These observed differences are likely multifactorial and should be acknowledged when counseling patients.

Finding the Optimal Augmented Glenoid Design: A Finite Element Analysis

Abstract ID: Paper 203

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INTRODUCTION: Novel augmented glenoid implants have been developed to assist in the correction of glenoid retroversion and potentially minimize revision surgeries. Improved outcomes are achieved via correcting retroversion and restoring normal biomechanics. Our goal was to identify the optimal augmented glenoid design based clinically relevant range of motion utilizing finite element analyses (FEA).

MATERIALS AND METHODS: Computer-aided-design (CAD) of two commercially available augmented glenoid implants, posterior wedge and posterior step, were tested utilizing precise manufacturer dimensions and augment sizes. Designs were virtually implanted to correct 20° glenoid retroversion with simulated abduction using kinematic modeling. Glenohumeral contact pressure, cement and shear stress, and strain around the implant and relative micromotion of the implant and at the bone-cement interface were assessed. Biomechanical response parameters were compared.

RESULTS: During abduction, strain was higher in stepped design (1-2%) than wedged design (0.4-1.2%). Stepped models sustained 30% - 70% higher stresses than wedged models at different corrections. Distractions predicted by stepped designs were twice as high as wedged model (0.17 vs. 0.06 mm). Similarly, compression values were 1.5-8x higher in stepped designs. Predicted glenoid translations were similar (0.10 vs. 0.11 mm). The summative effect of the values for distraction, compression, and translation show that the stepped design experienced more micromotion.

DISCUSSION: Clearly augmented glenoid implants provide an important option when treating significant glenoid bone loss. Our study showed wedged designs experience less stress and micromotion with abduction loading ultimately pointing to decreased failure rates and increased performance.

SUMMARY: FEA model was used to identify optimal augmented glenoid design during functional abduction motion. Wedged augment design appears to have less stress and micromotion than stepped designs which leads to increased survival of the implant.

A Comparison of Patient Satisfaction Following Outpatient vs. Inpatient Total Shoulder Arthroplasty

Abstract ID: Paper 204

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BACKGROUND: Outpatient total shoulder arthroplasty (TSA) 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 the outpatient compared to the inpatient setting. We proposed to evaluate satisfaction with outpatient TSA performed in a freestanding ambulatory surgery center (ASC) compared to the inpatient (INPT) setting.

METHODS: Following Institutional Review Board approval, 81 patients undergoing primary TSA were surveyed to address satisfaction with the facility and procedure as well as any post-operative problems. The questions addressing patient satisfaction regarding the surgery and facility utilized a 5-point Likert scale. Satisfaction with the setting of care (ASC or hospital) and whether the patients would have TSA again were assessed with a 3-point nominal scale. The survey also asked whether the setting of the patient's surgery would have changed, if given the opportunity to have the procedure in a different location (ASC versus hospital). All patients were more than 90 days removed from their procedures at the time of survey. Paired t-tests and chi-square analysis were used to determine differences ($p < 0.05$) between the two groups.

RESULTS: Thirty-five patients in the ASC group and 46 patients in the INPT group completed the survey. Between the two groups, patients had similar satisfaction regarding their outcomes from the surgery (89% very or extremely satisfied in the ASC group vs. 94% INPT, $p = 0.606$) and their experiences at the location of their procedure (94% very or extremely satisfied in the ASC group vs. 87% INPT, $p = 0.196$). There were no differences between groups regarding re-admission rates, the need to seek medical care following surgery, or surgical site infections ($p > 0.05$). More patients (13%) in the INPT group would have changed their setting to the outpatient environment, if given the opportunity, than vice versa (2.9%) in the ASC group ($p = 0.035$).

CONCLUSION: Patients undergoing shoulder arthroplasty, whether in an inpatient setting or ambulatory surgery center, expressed high levels of satisfaction with the operation as well as the environment of their surgery. Further, there was no difference between the two groups in terms of the need to seek medical care following shoulder arthroplasty. Given the choice, however, the ASC group preferred having their surgery in the ASC setting, while a higher percentage of patients in the inpatient group would have preferred to change to an outpatient environment, if possible.

CT vs. Templating Software Measurement of Glenoid Parameters in Osteoarthritis

Abstract ID: Paper 205

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BACKGROUND: Preoperative templating prior to shoulder arthroplasty is important for surgeons to gain an understanding of the osseous morphologies of the glenoid and humerus. The accurate assessment of glenoid morphology prior to shoulder arthroplasty is critical in order to maximize implant longevity by decreasing likelihood of implant malposition or failing to recognize significant humeral head subluxation. Traditionally, glenoid retroversion, humeral head inclination and head subluxation have been most accurately measured manually on a computed tomography (CT) scan. However, the use of 3D templating software based on the DICOM data is gaining popularity, particularly as patient-specific software becomes more sophisticated. The accuracy of different types of CT scans (i.e., 2D versus 3D), as well as the accuracy of templating software combined with the subsequent creation of patient-specific instrumentation have been studied. However, few studies have assessed the accuracy of templating software-generated measurements. We hypothesized that the measured values generated by one single templating software would differ from measurements obtained by the manual measurement of CT imaging.

METHODS: CT imaging from 95 patients with a diagnosis of primary osteoarthritis were included in this study. The CT scans were obtained as preoperative studies for patients undergoing shoulder arthroplasty. The DICOM data were uploaded into a templating software that provided 3D reformatted images of each file. Glenoid version was measured on axial CT images according to the method described by Friedman. Glenoid inclination was determined as the angle subtended by one line along the deepest point of the supraspinatus fossa and one line that connected the superior and inferior glenoid margins. Humeral head subluxation was determined based on the method of Walch et al. (1999). Each manually measured parameter was compared to the template-generated measurement in a pair-wise fashion using a Sign Test, with $p < 0.05$ considered statistically significant.

RESULTS: All of the template software's measurements were significantly larger than the measurements obtained by manual measurement. There was a mean of 3.6° difference in version between the template software and the manual measurements (17.4° versus 13.8° , respectively; $p < 0.0001$), 18° difference in subluxation (74.2° versus 56.2° ; $p < 0.0001$) and 4.3° difference in inclination (80.7° versus 76.4° ; $p = 0.001$).

DISCUSSION: This study demonstrated that there were significant differences between all of the measurements of interest obtained manually on a CT scan versus those delivered by a template-software program. The software delivered greater version, subluxation and inclination values versus the manual measurements.

In a study only including B2 glenoids, Chamberlain et al. compared measurements from 2D CT images to those obtained from automated software and learned that the software delivered

significantly different measurements, both for measurements obtained on scans that were corrected in the scapular plan as well as those that were uncorrected. Given the increasing use of 3D software for the assessment of glenoid morphology prior to arthroplasty, studies such as this will be important to help guide improvement in the automated templating process.

Reverse Shoulder Arthroplasty in the Era of Disease-Modifying Antirheumatic Drugs

Abstract ID: Paper 206

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INTRODUCTION: There is limited literature with varying results regarding reverse shoulder arthroplasty in rheumatoid arthritis. The objective of the present study was to retrospectively review clinical and radiographic outcomes of patients who underwent reverse shoulder arthroplasty for rheumatoid arthritis and other inflammatory arthropathies and provide a comprehensive analysis to identify factors that may alter patient outcomes.

METHODS: We performed a retrospective study of 91 primary reverse shoulder arthroplasties performed between 2006-2013 for patients who carried a diagnosis of inflammatory arthritis. Seventy-five had at least two years of follow-up with an average follow-up of 4.0 years. In the perioperative period, there were 19 (25%) on methotrexate, 24 (32%) on steroids, and 19 (25%) taking a biologic. Outcomes evaluated included revision and reoperation rates, complications, American Shoulder and Elbow Surgeons (ASES) scores, simple shoulder test (SST) scores, component loosening, and scapular notching.

RESULTS: In the perioperative period, there were 19 (25%) on methotrexate, 24 (32%) on steroids, and 19 (25%) taking a biologic (i.e., TNF-alpha inhibitor). Eighteen (24%) glenoid components required augmentation with corticocancellous autograft from the humeral head. Cemented humeral components were used in 23 (31%) arthroplasties. There were 4 (5%) nondisplaced intraoperative fractures involving the greater tuberosity that occurred during implantation. Follow-up data was available for all shoulders at a mean follow-up of 4.0 years (2.0-10.0) or just prior to revision surgery. Revision surgery was performed in 1 (1.4%) patient who sustained a displaced periprosthetic fracture involving the humeral component at 1.8 years postoperatively. The patient was treated with a revision reverse shoulder arthroplasty involving an allograft prosthetic composite. The overall implant revision-free survival at 2 and 5 years was 99% and 99%, respectively. No variables analyzed had a significant impact on the rates of revision surgery. After primary RSA in patients with inflammatory arthritis, there was 1 additional postoperative complication requiring a reoperation but components were retained. Reoperation was performed for a deep periprosthetic infection at 1.5 years postoperatively that was treated with irrigation and debridement. The patient had a total hip arthroplasty infection simultaneously, also requiring irrigation and debridement, but component retention. The patient was on Plaquenil and prednisone at the time of the infection. The patient remained on antibiotic suppression through the remainder of their life (1.5 years). The 2- and 5-year reoperation-free survival were both 97%. Besides the patient requiring revision surgery, no other patients suffered a postoperative periprosthetic humerus fracture. Additional postoperative fractures included 3 (4%) scapular spine fractures and 3 (4%) acromial fractures, all of which were managed non-operatively and had no significant effect on clinical outcomes. There were no additional postoperative infections. No patient had any wound healing complications.

Overall, there was a significant improvement in the patients' postoperative pain levels

($p < 0.001$), shoulder abduction ($p < 0.001$), and shoulder external rotation ($p = 0.001$). Furthermore, patients had high rates of satisfaction, as well as ASES and SST scores. Univariate analysis identified higher SST scores with increasing BMI ($p < 0.02$) and with cemented humeral components ($p < 0.02$). Additionally, laborers were found to have lower postoperative pain ($p < 0.05$) and higher ASES scores ($p < 0.05$). No other variables, including use of prednisone, DMARDs, or biologic medications, had a significant impact on postoperative shoulder motion, function, or pain levels. Multivariate analysis was performed using the standard-least squares with ASES and SST as the dependent variables. For every unit increase in BMI, the SST score increased by 0.2 ± 0.07 points. ($p < 0.01$).

There were 2 (2.7%) grossly loose glenoid components with obvious changes in position. Both patients had minimal symptoms and did not wish to undergo revision surgery. Neither of these patients were on prednisone, methotrexate, or a biologic drug. There were no cases of humeral component loosening aside from the one revision case in which a patient sustained a periprosthetic humeral fracture resulting in loss of humeral fixation. There was no evidence of radiolucencies around the humeral component in the remainder of the arthroplasties. Scapular notching was observed in 11 (15%) shoulders, while grade 3 or higher scapular notching was demonstrated in 4 (5%) shoulders. No factors had a significant influence overall on glenoid component loosening or scapular notching.

DISCUSSION: The findings in this study suggest that reverse shoulder arthroplasty is a reliable option with a low complication rate for the treatment of symptomatic glenohumeral arthropathy in the setting of inflammatory arthritis.

Shoulder Arthroplasty After Previous Proximal Humerus Internal Fixation

Abstract ID: Paper 207

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INTRODUCTION: Post-traumatic arthritis develops in a number of patients after internal fixation of proximal humerus fractures. While shoulder hemiarthroplasty may be considered in patients with minimal glenoid involvement, total shoulder arthroplasty using either anatomic or reverse components is expected to provide better pain relief for patients with glenoid articular cartilage damage. Reverse arthroplasty has increased in popularity for the post-traumatic shoulder in general, but the outcome of anatomic or reverse shoulder arthroplasty (TSA and RTSA) specifically in patients with glenohumeral arthritis after proximal humerus fracture fixation has not been analyzed in detail.

METHODS: Between 1999 and 2013, 49 consecutive patients underwent TSA (n=22) or RTSA (n=27) for end-stage glenohumeral arthritis after previous internal fixation of a proximal humerus fracture. The mean age of the 49 patients was 67 years (± 10 years), and all were followed for a minimum of 2 years (median 60, range 24-182 months). Shoulders treated with a hemiarthroplasty in the absence of glenoid arthritis during the same period were excluded. Implantation of a TSA or RTSA was at the treating surgeon's discretion based on preoperative and intraoperative findings related to the condition of the rotator cuff and tuberosities.

RESULTS: Range of motion, pain, and strength in active forward elevation (FE), external rotation (ER), and internal rotation (IR) were significantly improved in both groups ($p < .001$). However, the outcome of reverse arthroplasty was better than anatomic shoulder arthroplasty in FE (73° vs. 29° improvement, $p < .0001$), FE/ER strength ($p < .0001$), and pain ($p < .0001$). The TSA group, however, showed significant improvement in IR ($p < .0001$) and IR strength ($p < .0001$). The RSA group had worse preoperative FE (50° vs. 76°) and greater postoperative FE (123° vs. 105°). There were 6 reoperations in 3 patients (3 reoperations in 1 RSA patient, and a total of 3 reoperations in 2 TSA patients). Reoperations were performed for component loosening in 3 cases and for instability in 3 cases.

DISCUSSION AND CONCLUSION: Reverse shoulder arthroplasty provides better pain relief, strength, and active elevation when compared to anatomic shoulder arthroplasty for treatment of glenohumeral osteoarthritis after previous internal fixation of a proximal humerus fracture. However, restoration of internal rotation is more reliable using anatomic components.

Effect of Intraoperative Hypothermia on Shoulder Arthroplasty

Abstract ID: Paper 208

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BACKGROUND: Intraoperative hypothermia has been evaluated for associated perioperative complications in other orthopedic surgeries; however, there has been limited evidence with regards to shoulder arthroplasty.

PURPOSE: To determine the incidence of intraoperative hypothermia in patients treated with shoulder arthroplasty and evaluate its effect on perioperative complications.

METHODS: Retrospective chart review was performed on 657 consecutive patients who underwent shoulder arthroplasty at our institution between August 2013 and June 2016. Patient demographic data, surgery-specific data, postoperative complications, length of stay, and 30-day readmission were recorded. Patients with a mean intraoperative temperature less than 36°C were identified as hypothermic. Statistical analysis with univariate and multivariate logistic regression were performed to evaluate the association of intraoperative hypothermia with perioperative complications.

RESULTS: The incidence of intraoperative hypothermia in shoulder arthroplasty was 52.7%. Increasing age ($p=.002$), lower body mass index ($p=.006$), intra-scalene anesthetic ($p=.004$), and lower WBC count ($p<.001$) demonstrated increased association with hypothermia. In contrast to previous studies, longer operating room times and increased estimated blood loss was not found to be associated with intraoperative hypothermia. Hypothermia demonstrated no significant association with surgical site infections nor any other perioperative complications.

CONCLUSION: The current study demonstrates the high incidence of intraoperative hypothermia in patients undergoing shoulder arthroplasty. Surgeons must be mindful of lower BMI, increasing age, intra-scalene block use, and lower WBC count leading to an increased incidence of hypothermia. Contrary to previous studies, intraoperative hypothermia in shoulder arthroplasty was not found to have a role in perioperative complications.

Radiographic Comparison of Stemmed and Stemless Shoulder Arthroplasty

Abstract ID: Paper 209

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BACKGROUND: Shoulder arthroplasty is a reliable solution for patients with degenerative glenohumeral disease. Prostheses which reproduce the anatomy and restore the center of rotation (CoR) have superior clinical outcomes. Stemless implants have theoretical benefits over stemmed implants, including ability to restore the CoR independent of the humeral shaft axis. The purpose of this study was to radiographically compare stemmed and stemless shoulder arthroplasty implants regarding restoring pre-surgery anatomy and CoR.

METHODS: A consecutive cohort of 42 shoulder arthroplasties was performed by a single experienced surgeon (21 stemmed, 21 stemless). Six anatomic parameters were defined, measured, and compared pre- and postoperatively on standard radiographs: Humeral Head Height (HHH), Humeral Head Centering indexed to the glenoid length (HHC), Humeral Head Medial Offset (HHMO), Humeral Head Diameter (HHD), Humeral Neck Angle (HNA), and Lateral Humeral Offset (LHO). Measurements were scored and summed to achieve the Anatomic Reconstruction Index (ARI). Measurements were compared using a Student t-test with significance set at $\alpha=0.05$.

RESULTS: The ages (59 vs. 55 years) and gender distribution (11 male, 10 female vs. 6 male, 15 female) differed between the stemmed and stemless groups. None of the measured radiographic differences achieved statistical significance. Of the 4 measurements that are prosthesis dependent (HHH, HHMO, LHO, and HHD), 3 demonstrated lower but not significant average pre- to postoperative difference with stemless implants. Specifically, 2.63 mm for the stemless vs. 3.24 mm for the stemmed implant for HHH ($p=0.56$), 1.39 mm vs. 1.71 mm ($p=0.42$) for HHMO, 3.71 mm vs. 6.16 mm ($p=0.33$) for LHO and 2.07 mm vs. 1.9 mm ($p=0.76$) for HHD. Soft tissue dependent measurements (HNA and HHC), showed an average pre- to postoperative HNA variation of 7.8° for the stemless implant vs 5.8° for the stemmed. Pre- to postoperative HCC variation were 7.52% and 8.56% for stemless and stemmed implants, respectively. Regarding the composite ARI scores, no differences were identified (7.24 for stemless vs. 7.33 for stemmed implants; $p=0.83$).

CONCLUSION: Equivalent radiographic restoration of shoulder anatomy and the CoR was found between stemmed and stemless implants. Stemless shoulder arthroplasty may have theoretical benefits but improved restoration of anatomy was not appreciated in this consecutive cohort series.

Can Machine-Learning Algorithms Be Used to Improve Short-Term Severe Adverse Event and Readmission Prediction Following Primary Total Shoulder Arthroplasty?

Abstract ID: Paper 210

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BACKGROUND: Total shoulder arthroplasty (TSA) is a likely target for future bundled payment initiatives, necessitating accurate preoperative risk stratification and prediction. In other specialties such as cardiology and oncology, machine-learning techniques have been shown to improve risk prediction for post-procedural complications and to minimize data collection burden via more parsimonious models. The purpose of this study was to assess the ability of four machine-learning algorithms to (1) improve prediction of 30-day readmission and severe adverse events (SAEs) following primary TSA, and (2) to do so using risk models containing only the most predictive data elements.

METHODS: We identified 9,043 patients in the American College of Surgeons National Surgical Quality Improvement Database (NSQIP) who underwent primary TSA between 2011 and 2015. Predictors included demographics, comorbidities, laboratory, and intraoperative variables. Outcomes of interest included 30-day unplanned readmission and 30-day SAEs. Four machine-learning algorithms—logistic regression (LR), random forest (RF), an adaptive boosting algorithm (AB), and a neural network (NN)—were trained on the derivation cohort (2011-2014 TSA patients) to predict for the outcomes mentioned above, and then applied to the validation cohort (2015 TSA patients). The c-statistic was used as a measure of predictive value of each model. A threshold-based selection method was then used to select variables that individually accounted for ≥ 0.10 of full-model risk prediction. The algorithms were retrained using only those variables above this threshold to determine the predictive ability of algorithms trained on limited-set models.

RESULTS: The derivation and validation cohorts were comprised of 5,857 and 3,186 primary TSA patients, respectively, with similar demographics, comorbidities, and rates 30-day unplanned readmission (2.9% vs. 2.7%) and 30-day SAEs (2.5% vs. 2.4%). The machine-learning algorithms achieved acceptable risk prediction for 30-day SAEs (c-statistic for LR: 0.65, RF: 0.66, AB: 0.60, NN: 0.64) and 30-day readmissions (LR: 0.70, RF: 0.67, AB: 0.69, NN: 0.61). For both outcomes, body mass index (SAE prediction contribution = 0.46, readmission prediction contribution = 0.46) and age (0.22, 0.20) passed the prediction threshold (≥ 0.10). Algorithms trained on only these variables achieved lower risk prediction for 30-day SAEs (LR: 0.57, RF: 0.56, AB: 0.56, NN: 0.54) and 30-day readmissions (LR: 0.60, RF: 0.62, AB: 0.57, NN: 0.61).

CONCLUSION: Machine-learning techniques achieve moderate predictive accuracy for short-

term complications and readmission following primary TSA with certain algorithms outperforming logistic regression. Limited-variable risk models are moderately less predictive while greatly minimizing data collection burden.

Outcome of Reverse Shoulder Arthroplasty with Pedicled Pectoralis Transfer in Patients with Deltoid Paralysis

Abstract ID: Paper 211

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PURPOSE: Management of shoulder arthritis associated with deltoid paralysis could be very challenging. The purpose of this study is to report the outcome of reverse shoulder arthroplasty and pedicled pectoralis transfer to reconstruct the anterior deltoid in patients with symptomatic shoulder arthritis and paralyzed deltoid.

METHODS: Thirty-one patients with an average age 51 (range, 27-73 years) are included in this study. All patients have chronic deltoid paralysis with significant loss of function secondary to progressive arthritis associated with rotator cuff deficiency. All patients underwent reverse shoulder arthroplasty with pedicled pectoralis muscle transfer of the clavicular and upper sternal border. Additional transfers were performed for patients with no preoperative external rotation: 5 patients underwent latissimus transfer and 3 patients underwent direct lower trapezius transfer to the infraspinatus.

RESULTS: At an average follow-up of 37 months, 29 patients had significant improvement of pain, shoulder subjective value (SSV), and Disabilities of the Arm, Shoulder, and Hand score and shoulder range of motion, mainly flexion, 83°; and external rotation, 15°. Two patients sustained postoperative acromial fracture and had persistent pain after surgery with minimal improvement of shoulder flexion and external rotation. One of them failed attempt at ORIF of the acromion.

CONCLUSION: Reverse shoulder arthroplasty with pedicled pectoralis transfer is a promising procedure that may lead to improved pain and function in patients with shoulder arthritis associated with deltoid paralysis.

The Effect of Morbid Obesity on Revision and Reoperation Following Revision Reverse Shoulder Arthroplasty

Abstract ID: Paper 212

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PURPOSE: BMI has previously been associated with increased complication rates following primary reverse shoulder arthroplasty. The incidence of revision reverse shoulder arthroplasty (rRSA) is increasing due to the popularity of primary RSA. To date, there is little known regarding outcomes rRSA in the setting of obesity.

METHODS: Revision RSAs performed for a failed primary anatomic and reverse total shoulder arthroplasty at our institution were reviewed between 2004-2012, excluding patients with < 2 years of follow-up. 179 patients (180 shoulders) were included in our study, with an average age at the time of revision of 69 years (range, 39-89). There were 56.4% females and 9 laborers. Comorbidities included smoking (n=19), diabetes mellitus (n=29), and rheumatoid arthritis (n=12). Average BMI was 31.1 kg/m² and n=49 patients had BMI > 35. Mean follow-up was 3.9 years (range, 2.0-10.0).

RESULTS: 22 patients (12.3%) developed postoperative complications requiring revision surgery at mean 1.4 years postoperatively. The etiologies for revision surgery were instability (n=4), glenoid loosening (n=14), humeral component fracture (n=1), and infection (n=3). Four revisions occurred in the morbidly obese group; 18 revisions occurred in patients with BMI ≤ 35. The 2- and 5-year survival-free of revision surgery were 90% and 87%, respectively for patients with BMI ≤ 35 and 94% and 92%, respectively for BMI > 35 (p = 0.29). There were 11 additional non-revision reoperations with two occurring in the morbidly obese group and nine occurring in patients with BMI ≤ 35. The 2- and 5-years survival-free of any reoperation were 86% and 78% respectively for patients with BMI ≤ 35 and 90% and 80% for BMI > 35 (p = 0.21).

Overall, patients experienced excellent pain relief, with 20 (11%) of patients reporting moderate or severe pain postoperatively compared to 145 (81%) preoperatively (p < 0.01). The average postoperative ASES and simple shoulder test (SST) score were 66.8 and 6.2, respectively with no difference noted between BMI groups.

CONCLUSIONS: Revision reverse shoulder arthroplasty, when used in the setting of morbid obesity is a successful procedure. No significant differences were noted between morbidly obese patients and patients with BMI ≤ 35 in terms of revision, all-cause reoperation, or postoperative patient reported outcome scores.

Preoperative Comorbidities Predict Lower Physical Therapy Compliance Rates After Shoulder Arthroplasty

Abstract ID: Paper 213

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INTRODUCTION: Participation in postoperative physical therapy is an important part of rehabilitation following shoulder arthroplasty; however, the effect of common comorbid conditions on patient compliance with the physical therapy regimen remains unknown. The purpose of this study is to compare physical therapy compliance rates in patients with and without a history of smoking, mood disorders, and preoperative narcotic pain medication use.

METHODS: 214 shoulders undergoing primary anatomic (TSA) and reverse (RTSA), were identified. Postoperative physical therapy was conducted using a standardized 12-week shoulder arthroplasty program. Preoperative risk factors were captured in the electronic medical record, and included history of mood disorder, chronic preoperative narcotic use, and tobacco use. Compliance rates in the 90-day global period following surgery were calculated by identifying attendance at physical therapy appointments. Compliance rates were then compared by the presence or absence of these risk factors. Two-tailed t-tests were used to determine the significance of any differences in compliance between groups.

RESULTS: A total of 214 shoulder arthroplasties (92 RTSA, 122 TSA) performed by a single surgeon were identified. In the global period following surgery, 82% of all physical therapy visits were kept. The overall compliance rates for the RTSA and TSA groups were similar at 83% and 82% respectively ($p=.66$). Patients with a history of mood disorder had a significantly lower compliance rate (76%) than those without (85%, $p=.004$). Patients with a history of smoking had significantly lower compliance rates at 79% vs. 83% ($p=.05$). Patients with a history of chronic preoperative narcotic use showed a strong trend toward lower compliance at 78% vs. 84% ($p=.06$). 42 patients had multiple concurrent comorbidities, with a compliance rate of 72%. Patients with multiple comorbidities were significantly less compliant than patients with a single comorbidity (82%, $p=.017$), or patients with no comorbidities (85% $p=.001$). There were no statistically significant differences between groups regarding laterality.

CONCLUSION: Patients with mood disorders and a history of tobacco use have a significantly higher rate of noncompliance with postoperative physical therapy programs after shoulder arthroplasty. History of preoperative narcotic use also trended strongly toward decreased compliance. Our data also suggest that the effects of these risk factors may be additive, with patients diagnosed with multiple comorbid conditions having the lowest therapy compliance rate of any group. Patients with the identified comorbidities may benefit from preoperative counseling and management of these risk factors in order to achieve optimal results after shoulder arthroplasty.

Subscapularis Repair is Unnecessary After Lateralized Reverse Shoulder Arthroplasty

Abstract ID: Paper 214

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BACKGROUND: Controversy exists as to whether the subscapularis should be repaired after reverse shoulder arthroplasty (RSA). The purpose of this study was to evaluate the utility of repairing the subscapularis after RSA with regard to complications, objective findings, and patient reported outcomes measures.

METHODS: Ninety-nine patients who underwent a lateralized RSA were retrospectively reviewed. Fifty-eight patients underwent subscapularis repair while 41 did not. Outcomes were compared with a Single Assessment Numeric Evaluation (SANE), Penn Shoulder Score (PSS), and the American Shoulder and Elbow Surgeons (ASES) Score at a minimum 2-year follow-up. Demographics, range of motion (ROM), and complications were also compared. A one-way ANOVA was performed to determine differences in performance and outcome scores while a chi square analysis was performed to compare the frequency of complications between groups.

RESULTS: The subscapularis repair versus no repair groups demonstrated no statistically significant differences in SANE, PSS, ASES, or VR-12 scores. Postoperative ROM was similar for forward elevation (128 vs. 123 degrees; $P = 0.44$) and external rotation (33 vs. 29; $P = 0.29$). In patients receiving subscapularis repair, postoperative forward flexion was increased with a subscapularis peel versus tenotomy (136 vs. 117, $p = 0.03$). There were no differences in the dislocation rate (5% vs. 2%, $p = 0.49$) or overall complication rate (9% vs. 5%, $p = 0.47$).

CONCLUSIONS: These results suggest that repair of the subscapularis tendon after lateralized RSA may not be necessary.

Subscapularis Sparing Anatomic Total Shoulder Arthroplasty Through a Superolateral Approach: A Radiographic Comparative Analysis

Abstract ID: Paper 215

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INTRODUCTION: Despite favorable outcomes with anatomic total shoulder arthroplasty (TSA) for glenohumeral arthritis, complications including subscapularis insufficiency can lead to pain, weakness, instability, and poor motion. To help avoid subscapularis tendon complications, novel subscapularis sparing approaches have been developed. The purpose of this study is to radiographically compare TSA using a superolateral subscapularis sparing (SSS) technique through the rotator interval to a traditional deltopectoral (DP) approach.

METHODS: Two consecutive cohorts of patients undergoing TSA by a single surgeon (DPA) were identified. One group was treated with a SSS approach. The other group was treated using a traditional DP subscapularis take down and repair technique. Pre- and postoperative radiographic measurements of humeral head height (HHH), humeral head centering (HHC), humeral head medial offset (HHMO), humeral head diameter (HHD), head-neck angle (HNA), residual osteophytes, and coracohumeral offset (CHO) were made by a single, independent, blinded reviewer. The HHH, HHC, HHMO, HHD, and HNA were compared to preoperative imaging and scored to calculate an anatomic reconstruction index (ARI). Comparison between the deltopectoral approach group and superolateral subscapularis sparing approach was completed using a t test assuming unequal variance.

RESULTS: Ninety patients receiving a TSA via the SSS approach (n = 70) or DP approach (n = 20) were analyzed. There were no significant differences in HHH, HHMO, CHO and residual osteophytes between the two groups. There were significant differences in HHD, HNA, and HHC between groups. Greater HHD values were appreciated in the DP group compared to the SSS group (p=0.002). For HNA measurements there was a 3.1 degree difference between the DP and SSS techniques (p=0.004). For the HHC measurement, the SSS cohort was 5.57 and the DP group was 3.46 (p=0.004). Regarding the ARI, there was no difference between the groups.

CONCLUSIONS: Radiographic comparison of two TSA surgical techniques, the superolateral subscapularis sparing and deltopectoral approaches, identified no significant difference in four of seven radiographic measurements in addition to the overall anatomic reconstruction index. The superolateral subscapularis sparing TSA approach appears to be a reasonable surgical approach to yield similar radiographic measurements as a traditional deltopectoral TSA approach.

Sleep Quality in Patients with Adhesive Capsulitis

Abstract ID: Paper 216

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BACKGROUND: Patients with adhesive capsulitis have been previously shown to have disturbances in sleep quality. While the presence of shoulder pain is certainly a contributing factor, other factors may play a role in the poor sleep quality observed in these patients. The purpose of this study is to identify factors that correlate with sleep disturbances in patients with adhesive capsulitis.

METHODS: This study analyzed 101 consecutive patients diagnosed with adhesive capsulitis. At the initial visit, the patients completed a comprehensive shoulder questionnaire including the Pittsburgh Sleep Quality Index (PSQI), Visual Analog Scale (VAS), American Shoulder and Elbow Society Shoulder (ASES) score, Single Assessment Numeric Evaluation (SANE) rating, a self-reported comorbidity index, and Short Form 12 (SF-12) at their initial visit. Additional demographic and historical data were obtained at the initial visit. A multivariate regression analysis was performed to identify factors correlating to sleep disturbance in these patients.

RESULTS: There were 50 patients in the inflammatory phase, 48 in the frozen phase, 2 thawing, and 1 unclassified. The average VAS score was 5.9 with 93% of patients endorsing a score of >1 . Of those endorsing pain, 95% reported the presence of nocturnal shoulder pain as well. There was a significant difference ($p < 0.001$) noted between PSQI scores in the differing stages of disease with a mean score of 12.7 in the inflammatory phase, 9.6 in the frozen phase, and 2.5 in the thawing phase. Of the variables analyzed in the multivariate regression (ASES score, VAS pain score, disease stage, and self-report co-morbidity index) had a small relationship with PSQI scores with correlation values ($r > 0.25$). Sleep quality were entered into a regression model. These variables had a multiple R of 0.61 and a coefficient of determination of 0.37 indicating that 37% of the PSQI scores could be explained by using these variables.

CONCLUSION: It has been shown that poor sleep quality is associated with adhesive capsulitis, this study shows that the etiology of the sleep disturbances is likely multivariate in nature. While pain may play a significant role, the stage of adhesive capsulitis may be equally as important when determining a prognosis. Though several studied variables may be correlated with poorer sleep quality, this study demonstrates that there may be other undetermined factors contributing to the poor sleep quality of these patients.

Comparison of Distal Clavicle and Coracoid for Anterior-Inferior Glenoid Augmentation: An Anatomic Study

Abstract ID: Paper 217

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INTRODUCTIONS: Shoulder instability associated with anterior-inferior glenoid bone loss is challenging to treat and often requires augmentation of the glenoid. Potential autologous graft sites include the coracoid and iliac crest. Such procedures are technically difficult and have been associated with high complication rates. The distal clavicle has recently been described as an alternative graft choice, however, little is known about the adequacy of this option. The purpose of this anatomic study was to compare the dimensions of the distal clavicle and ipsilateral coracoid process.

METHODS: Bilateral distal clavicles, coracoids, and glenoids were harvested from 32 cadavers (64 shoulders). Shoulders with evidence of fractures, advanced degenerative changes, or prior surgery were excluded. A 10 mm distal clavicle and 20 mm coracoid graft were obtained. The length, width, height, and mass were all measured for each graft, and volume and density were calculated. Additionally, the potential articular graft surface area of the articular (lateral) clavicle, superior clavicle, lateral coracoid, and glenoid articular surface were calculated using specialized software (ImageJ, National Institute of Health, Bethesda MD). Clavicle and coracoid graft measurements were compared using a t-test. Surface area for glenoid bone loss was then calculated for each patient to find the area of 20%, 25%, 30%, 35%, and 40% bone loss. The surface areas of the articular clavicle, superior clavicle, and lateral coracoid were then compared for adequacy of supplementing each amount of bone loss.

RESULTS: Measurements from 59 shoulders were analyzed. The average height, length, and variability of the distal clavicle was greater than the coracoid. The average width of the distal clavicle was less than the coracoid. The average articular (lateral) area was $2.93 \pm 0.90 \text{ cm}^2$ for the distal clavicle, $2.76 \pm 0.62 \text{ cm}^2$ for the superior clavicle, and $1.50 \pm 0.34 \text{ cm}^2$ for the coracoid ($p < 0.0001$). Average volume was $2.36 \pm 0.83 \text{ cm}^3$ for the distal clavicle compared to $1.96 \pm 0.55 \text{ cm}^3$ for the coracoid ($p = 0.0024$). Average mass of the distal clavicle was $2.36 \pm 0.83 \text{ g}$ compared to $2.45 \pm 0.52 \text{ g}$ for the coracoid ($p = 0.0437$). Average density for the clavicle was $1.18 \pm 0.16 \text{ g/cm}^3$ which was significantly less than the coracoid density of $1.24 \pm 0.17 \text{ g/cm}^3$ ($p = 0.0008$). Both the articular and superior surfaces of the clavicle were able to restore greater glenoid surface bone loss than the lateral coracoid surface.

CONCLUSION: The distal clavicle as a potential glenoid autograft has larger dimensions with greater variability and lower bone density than the coracoid process.

MAOA BREAKOUT SESSION #15
SPORTS MEDICINE
April 21, 2018

Deep Venous Thrombosis Prophylaxis in Anterior Cruciate Ligament Reconstructive Surgery: What is the Current State of Practice?

Abstract ID: Paper 218

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INTRODUCTION: Venous thromboembolism (VTE) is a significant perioperative risk with many common orthopedic procedures. Currently, there is no standardized recommendation for the use of VTE prophylaxis for Anterior Cruciate Ligament (ACL) reconstruction.

METHODS: Surveys were emailed to the alumni networks of 4 large ACGME-accredited sports medicine fellowship programs. Questions were focused on their current practice with the use of chemical and non-chemical VTE prophylaxis.

RESULTS: Surveys were completed by 142 surgeons in the United States; response rate of 32%. Of those that responded, 50.7% stated they routinely use chemical prophylaxis with 95.5% of those using Aspirin (ASA). There was no standardized dosing protocol with 46% using ASA 325 mg one time a day, 26% using ASA 325mg twice daily, 18% ASA 81mg one time daily, and 10% ASA 81mg twice daily. The most common reason for not using chemical prophylaxis was it is unnecessary given the low risk of VTEs. Physicians also based their prophylaxis regiment more on their own clinical experience than concern for litigation.

DISCUSSION AND CONCLUSION: Half of all sports medicine fellowship-trained surgeons surveyed routinely use chemical VTE prophylaxis after ACL reconstruction, with >90% of those using ASA. Of those using ASA, there was no prevailing dosing protocol. For those not using chemical prophylaxis, the most important reason for not was that it was felt to be unnecessary due to the risks outweighing the benefits. Those that do not regularly employ chemical prophylaxis would be willing to, however, if a patient had a personal or family history of clotting disorder or is currently on birth control. Additionally, clinical experience was the number one driver for current DVT prophylaxis protocol.

Utility of Merchant View Radiographs for Assessment of TT-TG: A Comparison to MRI

Abstract ID: Paper 219

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INTRODUCTION: Lateralization of the tibial tubercle is most often assessed by TT-TG distance measured on CT or MRI with the knee in extension. However, tracking of the patella in 30 to 45 degrees of flexion may be of greater clinical significance. Merchant radiographs can demonstrate the position of the tibial tubercle relative to the trochlear groove in this range of flexion and, thus, may serve as a valuable tool in the assessment of patellar tracking.

METHODS: To validate Merchant TT-TG, 41 patients between the ages of 10-18 had standardized Merchant radiographs in 45 degrees flexion yielding imaging of 82 knees. Lead markers were placed upon the skin centered over the tibial tubercle based on palpation. Radiographs were collected and analyzed. The TT-TG was measured as the distance between lines centered over the deepest point of the trochlear groove and the center of the tibial tubercle and perpendicular to the anterior condylar axis. In order to correlate Merchant TT-TG to MRI TT-TG, 16 additional patients were added to reach a total of 30 patients with a Merchant radiograph and MRI, as power calculation determined 29 knees needed to detect a Pearson correlation coefficient (PCC) of .500. There was excellent interobserver reliability between two readers for Merchant TT-TG with and without use of a radiographic marker (ICC = .975 and .923 respectively).

RESULTS: The tibial tubercle was identified on Merchant radiograph in 67 images (81.7%). Merchant TT-TG measured via marker was very strongly correlated to measurement via bony landmarks alone (PCC = .848). The Merchant TT-TG measured via bony landmarks was strongly correlated to MRI TT-TG (PCC = .602). The strength of this correlation was increased by standardizing TT-TG by patellar width (PCC = .710). MRI TT-TG was increased in patients with patellar instability at 13.9 mm compared to 10.5 mm ($p < .01$); Merchant TT-TG was also increased in patients with patellar instability at 9.1 mm compared to 1.9 mm ($p < .001$).

CONCLUSION: Standardized Merchant radiographs without radiographic markers allowed for assessment of TT-TG in the majority of patients. Merchant TT-TG strongly correlates with MRI TT-TG but measured 5-8 mm smaller than MRI TT-TG.

SIGNIFICANCE: Merchant radiographs provide a less costly means to assess TT-TG in patients with suspected patellar instability and, thus, may serve as a valuable screening tool.

Hamstring Injury Trends in Major and Minor League Baseball: Epidemiologic Findings from the Major League Baseball Injury Surveillance System

Abstract ID: Paper 220

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BACKGROUND: Hamstring strains are a common injury for professional baseball players, which can result in significant time on the disabled list. However, no study has reported the current trends over time in hamstring strains in professional baseball.

HYPOTHESIS: Professional baseball players would have an increase in the incidence of hamstring strains from 2011-2016.

STUDY DESIGN: Descriptive Epidemiologic Study

METHODS: Injury data was prospectively collected from 2011-2016 for every Major League Baseball (MLB) major and minor league team and recorded in the MLB's Injury Surveillance System. Data collected for this study included date of injury, activity during injury, time lost, primary injury or re-injury, and player demographic information related to level of play, age, and position for all hamstring injury events. Injury rates were reported in injuries per athlete-exposure (A-E). Athlete-exposures were defined as the average number of players on a team who were participating in a game multiplied by the number of games.

RESULTS: From 2011 to 2016, the rate of hamstring stains has increased for professional baseball players. In the major leagues, there were 441 hamstring stains with an injury rate (IR) of 1.47 per 1000 A-Es compared to an IR of 0.7 in 2011. In the minor leagues, there were 2,192 hamstring strains with an IR of 1.37 per 1000 A-Es compared to an IR of 0.7 in 2011. The majority of injuries occurred at the pitcher position (41%). The most common mechanism of injury was base running (>50%), specifically to first base. Average days missed remained consistent at 27.2 days. Over half of hamstring strains in both the major and minor leagues resulted in more than 7 days of time loss. Furthermore, 14% of major league and 11% of minor league players had more than 30 days lost due to injury. In the major and minor leagues, the month of September had the highest frequency of hamstring injuries followed by April and May. Recurrent hamstring injuries resulted in six more days of time lost than primary injuries (median 15 vs. 9 days, $p = 0.003$).

CONCLUSION: The rate of hamstring strains in professional baseball players has increased over the past six years and results in a significant loss of playing time. Our study found that these injuries are affected by position played, running to first base, seasonal timing, and history of hamstring injury.

ACL Reconstruction in Adolescents: Mid-Term Results Using a Combined Biologic Approach

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BACKGROUND: Compared to adult patients, adolescents are at an increased risk of ACL graft rupture following ACL reconstruction (ACLR). Graft failure rates following successful ACLR have been reported to be as high as 30% among adolescent populations. Biologic agents, such as platelet-derived growth factors, remain an area of interest to improve healing. It is hypothesized that using a combined biologic augmentation (autologous growth factors and porous collagen membrane) may result in better outcomes for adolescents undergoing ACLR.

METHODS: Patients undergoing ACLR with a combined biologic augmentation, performed by the senior author with a minimum of 24 months follow-up were eligible for study enrollment. Study outcomes included the collection of patient-reported outcomes, ACL integrity and stability scores, ACL failure rate, and contralateral knee injury. Patient-reported outcomes including IKDC, Lysholm, Tegner, and SANE scores were collected. ACL integrity and stability was evaluated using Lachman and KT-1000 testing. Patients were also evaluated for graft size, return to play at the same competitive level, family history of ACL injury, and time to complete rehabilitation.

RESULTS: There were 74 patients, involving 81 knees. Forty of the patients were female and 34 were male. The average patient age was 16 years with a range of 12-20. Follow-up averaged 47 months (Range - 25 – 86). IKDC and Lysholm scores averaged 91 with a respective range of 64-100 and 61-100. The average SANE score was 95 (Range - 70-100). The KT-1000 side to side difference averaged 1.3 with a range of 0 to 4. Sixty-eight of the 74 patients (92%) returned to their pre-injury level of play. The average time to complete rehabilitation was 22 weeks (Range – 15-37). There were 24 patients who tore their contralateral ACL and 14 with a positive family history. There were 4 patients (5%) who suffered a rupture of their ACL graft.

DISCUSSION/CONCLUSIONS: In this series, we report the results of ACLR utilizing autologous hamstrings and a combined biologic augmentation in an adolescent population. The high rate of subsequent ACL injury after ACLR reported in younger patients in recent literature was not demonstrated in this series. There was a 92% return to pre-injury level of play and only a 5% graft rupture rate. Based on this series of patients, there may be a benefit to a combined biologic approach in ACLR in the young active patient population.

Who is Going to Fail a Quantitative Return to Play (RTP) Assessment? A Prospective Study on the Impact of Psychology and Pre-Injury Athletic Activity in Adolescents Following ACL Reconstruction

Abstract ID: Paper 222

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INTRODUCTION: The purpose of this study is to determine the incidence of adolescent athletes who undergo ACL reconstruction who do not pass a quantitative RTP clearance assessment at 6 months. A secondary objective is to evaluate the effect of demographics, associated injuries, pre-injury athletic activity, and/or psychosocial factors in passing a RTP assessment.

METHODS: Patients were recruited in a single pediatric sports medicine clinic when indicated to undergo an ACL reconstruction by one of two surgeons; were greater than 11 years old; desired to return to sports; and had a baseline Tegner score greater than 7. Revisions and multi-ligamentous reconstruction were excluded. Orthopedic and psychosocial patient reported outcomes measures (PROMs) were administered within 30 days prior to surgery and again at 6 months. All subjects completed a Y-Balance Functional Test (YBT) at 6 months as a return to play assessment. Subjects were required to have less than a 4 cm side to side difference in three directions and a composite score of > 90 to pass the YBT.

RESULTS: In this cohort (n=48, mean age 14.8 years; range 12-18; 26 males), 50% (24/48) failed the YBT. There was no difference in age, gender, or associated injuries between those who passed and failed. Subjects were more likely to have a YBT composite score of greater than 90 if their history of participation hours per week was greater (9.7 hrs/wk vs. 5.7 hrs/wk; $p=0.025$). Subjects were more likely to pass their YBT if they played their primary sports 44 weeks per year pre-injury (88.0% vs. 45.5%, $p=0.0124$; 81.3% vs. 30.0%, $p=0.0031$, respectively).

Subjects who failed the YBT demonstrated minimal improvement in the total Athletic Coping Skills Inventory (ACSI-28) at 6 months (mean change = + 0.4) as opposed to those who passed (mean change = +6.2; $p=0.010$). Furthermore, baseline ACSI-28 subscales of Coping with Adversity Score and Freedom from Worry Score were significantly lower in the failures than those that passed (7.0 vs. 8.9, $p=0.029$; 6.2 vs. 8.2, $p=0.032$, respectively).

CONCLUSION/DISCUSSION: Athletes who play sports < 44 weeks or spend significant time during their week playing sports have a higher chance of clearing their return to sport assessments at 6 months following an ACL reconstruction. Thus, recreational athletes or athletes who spend less time playing sports may benefit from additional physical therapy. The ACSI-28 may be a beneficial psychosocial preoperative PROM to identify those who may fail their RTP assessment.

Patellar Imbrication to Correct Patella Alta in Lateral Patellar Instability

Abstract ID: Paper 223

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BACKGROUND: Recurrent lateral patellar instability can result from multiple anatomic risk factors, including patella alta. Distalization of the tibial tuberosity is the most common surgical treatment for patella alta. However, in skeletally immature patients, a distalizing osteotomy can disrupt the apophysis leading to premature growth arrest and angular deformity. A novel technique was developed to address patella alta without a tibial tuberosity osteotomy in which there is a stepwise imbrication of the patellar tendon.

PURPOSE: To determine if this patellar tendon imbrication technique normalizes patellar height and if the shortened length is maintained at minimum 2-year follow-up.

METHODS: A total of 34 patients were identified after a retrospective chart review was performed on patients who underwent patellar imbrication from 2007-2013. Of those, 32 met (average age 19.8 years [R, 12-35]) inclusion criteria of (1) having undergone the patellar imbrication procedure by the senior author (JA), (2) have established patellar alta as defined by an abnormal Insall-Salvati index on preoperative radiograph, and (3) having had preoperative recurrent lateral patellar instability. Preoperative, initial (3 weeks) postoperative, and minimum 2-year postoperative lateral radiographs were analyzed using Insall-Salvati (IS), Blackburne-Peel (BP), and Caton-Deschamps (CD) indices to determine the amount of shortening that was achieved after the procedure and to what degree that shortening was maintained at minimum 2-year follow-up.

RESULTS: The average patellar tendon length preoperatively was 6.1 cm (R, 5-8). At the three weeks and two years, the average tendon length was 5.1 cm and 5.2 cm, respectively. Thus, the average change in patellar tendon length from preoperative to immediate postoperative was 0.97 cm (SD +/- 0.67). IS, BP, and CD ratios had minimal change (loss of correction) from 3-week to 2-year follow-up; the delta values were 0.04, -0.03, 0.09, respectively.

CONCLUSIONS: Patellar tendon imbrication is a safe and effective procedure to correct patella alta. On average, the technique allowed 1 cm of patellar tendon shortening and maintained the correction at two-year follow-up. In the skeletally immature patient, this technique allows avoidance of the tibial tuberosity apophysis and possible growth arrest associated with more traditional osteotomy techniques. Avoidance of osteotomy prevents the problems related to hardware fixation of standard tibial tuberosity osteotomies.

Risk Factors for Lateral Meniscus Posterior Root Tear in Patients with Anterior Cruciate Ligament Ruptures

Abstract ID: Paper 224

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BACKGROUND: Risk factors for medial meniscus posterior root tears (MMPRT) have been evaluated extensively in the literature. However, there are few reports evaluating lateral meniscus posterior root tears (LMPRT), which are more commonly injured with acute ACL injuries. The purpose of our study was to identify the risk factors for LMPRT in patients with acute ACL tears.

METHODS: A retrospective review was performed of 105 patients that were treated for ACL ruptures by a single surgeon. Demographic characteristics were collected as well as mechanism of injury and radiographic imaging. X-ray images were analyzed for tibia vara angle, tibial slope angle, and Kellgren-Lawrence grade (KLG). MRI images and reports were assessed for concurrent meniscal tears. Imaging reports identifying LMPRT were compared to intraoperative reports to determine accuracy. Logistic regression models were constructed to analyze for potential risk factors for LMPRT.

RESULTS: In total, 105 patients with a mean age of 27.2 ± 11.8 and a mean BMI of 28.0 ± 5.6 were included in the study. Ninety-seven percent of injuries were non contact, 78% of injuries occurred in high impact sports, and 81% of patients had evidence KLG 1 or 2. In patients sustaining a concurrent meniscal injury, there was an 8.5% incidence of MMPRT and a 16.0% incidence of LMPRT. When evaluating agreement of LMPRT with MRI and OR reports, there was a Kappa rate of .54. Patients with higher tibia vara angles were found to have a higher incidence of LMPRT (4.0 vs. 2.0; $p = .057$). Patients with a tibial slope angle < 12 had a decreased likelihood of having a LMPRT (OR 0.224; $p = .056$).

CONCLUSION: There was a higher rate of LMPRT than MMPRT in acute ACL injuries. The agreement rate between MRI and intraoperative findings is low in patients with LMPRT. Patients with higher tibia vara angles and a higher tibial slope angle were more likely to sustain a concurrent LMPRT. These findings suggest intrinsic risk factors that predispose to LMPRT when sustaining an ACL rupture.

Strength Changes Associated with Elongation After Distal Biceps Repair

Abstract ID: Paper 225

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BACKGROUND: Operative repair of distal biceps tendon ruptures have shown successful outcomes. However, little is known about the amount of tendon or repair site lengthening after repair and how this may affect strength. The purpose of our study was to evaluate distal biceps tendon repair via radiostereometric analysis and correlate with final strength changes.

METHODS: Eleven patients with distal biceps ruptures were recruited. During repair, two 2-mm tantalum beads with laser-etched holes were sutured to the distal biceps tendon. Beads were evaluated via CT scans immediately postoperatively and at 16 weeks. X-rays were obtained at time 0 and then at 4, 8, and 16 weeks. Seven patients were available for final strength testing at minimum of 9 months postoperative.

RESULTS: The mean amount of tendon lengthening after surgery was 24.3 mm (range 17.2 – 30.9 mm). The greatest change in lengthening was noted between time 0 and week 4 (mean: 13.1 mm, $p < 0.05$), with the least amount of lengthening between week 8 and week 16 (mean: 2.7 mm, $p < 0.05$). DASH averaged 9.2. Strength testing performed at final follow-up ($n=7$) showed 78% supination and 88% flexion strength compared to contralateral side. Tendon lengthening from 0-4 weeks was found to have the greatest association with loss of supination strength. (Correlation coefficient: -0.39). Final ultrasound evaluations found all tendons to be in continuity.

CONCLUSION: This study's findings suggest that all patients undergoing distal biceps tendon repair have significant lengthening after surgery. Most of the lengthening was noted in the early postoperative period, in which the greater amount of lengthening correlated with a greater loss of supination strength. Further studies will focus on postoperative protocols as they may have an impact on early tendon lengthening and could be adjusted to minimize this consequence on long-term supination strength.

Effect of Biceps Tenodesis on Speed of Recovery After Arthroscopic Rotator Cuff Repair

Abstract ID: Paper 226

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INTRODUCTION: Management of the biceps tendon during arthroscopic rotator cuff repair (RCR) remains controversial. While recovery following RCR has been shown to plateau at 1-year, there remains a paucity of knowledge the effect of biceps tenodesis (BT) has on speed of recovery (SOR). For this reason, we sought to analyze the effect of concomitant BT on the SOR and overall outcomes following RCR.

METHODS: A retrospective review of an institutional shoulder surgery registry was performed for all patients with primary arthroscopic RCR for full thickness tear from 2006 to 2015. Patients were subdivided into those receiving BT and those undergoing RCR-Only. Analysis was then performed for preoperative, 3-month, 6-month, and 1-year pain (Visual Analog Scale [VAS] Pain), function (Simple Shoulder Test [SST], American Shoulder Elbow Surgeon [ASES], VAS Function, SANE [Single Assessment Numeric Evaluation]), and measured motion (active elevation and external rotation). Plateau in maximal improvement was previously defined as the follow-up point at which no subsequent statistically significant improvement was observed between adjacent time intervals. SOR was previously defined as the percentage of the total improvement (achieved at the plateau point) attained at each follow-up interval for each outcome measure.

RESULTS: 535 patients who underwent BT or RCR-only met the minimum 6-month follow-up criteria. Preoperatively, no differences were observed in SST, SANE, VAS function, VAS pain, or motion. However, baseline ASES function was lower for the BT cohort (20.5) compared to RCR-only (23.9; $p=0.008$). The BT group had higher SST scores (9.6 vs. 9.0, $p=0.044$) and forward elevation (157° vs. 150° , $p<0.001$) at 6 months. No other significant differences in outcome scores were observed. Both cohorts improved in nearly all measures through 12 months. For VAS pain, forward elevation, and external rotation, the plateau in maximal improvement occurred at 6 months for the BT group and at 12 months for the RCR-only group. Plateau in maximal improvement for all other variables occurred at 12 months for both groups. At 3 months, SOR was 79% for pain and 42-49% for function in the BT cohort. The RCR-only cohort achieved a SOR of 73% for pain and 36-57% for function at 3 months.

CONCLUSIONS: Patients requiring RCR with simultaneous BT have lower baseline ASES Function Scores and earlier postoperative plateaus in pain relief and motion improvement following surgery. Nonetheless, SOR was not influenced by concomitant BT. Similar outcomes at all time points are observed when compared to RCR alone.

Medial Elbow Pain During the Return to Throwing Period After Ulnar Collateral Ligament Reconstruction

Abstract ID: Paper 227

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INTRODUCTION: Ulnar collateral ligament reconstruction (UCLR) is ever-present in the sport of baseball. Postoperative return-to-sport protocols attempt to help players safely get back to sport, with many players beginning to throw at 4-5 months and return to full competition between 12-16 months. Medial elbow pain during the return to throw period often occurs and can be difficult to manage. The purpose of this study was to evaluate the incidence of medial elbow pain and its correlation with outcomes and revision surgeries during the return to throw period after UCLR.

METHODS: All patients that underwent UCLR between 2002-2014 at a single institution were identified. Charts were reviewed for patient demographics, incidence of medial elbow pain during the return to throwing postoperative period, return to sport, and subsequent operative interventions, including revision-UCL surgery. Continuous variable data were reported as weighted means, and categorical variable data were reported as frequencies with percentages.

RESULTS: In total, 319 patients that underwent UCLR between 2002 and 2014 were evaluated. Medial elbow pain was experienced by 46.1% (147/319) with the average time of complaint 10.04 months after surgery. The groups were equally distributed with regards to age (pain: 20.9 years vs. no pain: 20.7 years) and level of sport (pain: 43 professional, 73 college, 29 high school, and 2 recreational players vs. no pain: 46 professional, 77 college, 42 high school, 1 jr. high school, and 2 recreational players). Of those that experienced medial elbow pain, 10.9% would not return to sport, 19% would later require other elbow operative interventions, and 4.8% required revision UCLR. In those that did not experience medial elbow pain when returning to throw, only 5.3% later required operative intervention, with only 2 later requiring revision UCLR and 8% did not return to sport.

DISCUSSION AND CONCLUSION: Medial elbow pain during the return to throwing period after UCLR is not uncommon, with approximately half of players experiencing pain. Results suggest that those that do experience medial elbow pain are at increased risk for further surgical intervention, revision surgery, and may be at increased risk to not return to sport.

Epidemiology of Crossfit-Related Injuries

Abstract ID: Paper 228

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INTRODUCTION: Crossfit is a sport with steadily increasing annual participation rates. Clinical encounters for Crossfit-related injuries are becoming more common due to higher participation, but limited published data exist on injury patterns in this sport, particularly by gender or age group. The purpose of this study is to describe Cross-fit related injury patterns over time and with respect to athlete gender and age.

METHODS: All patient encounters for a Crossfit-related injury since time of opening of the first Crossfit affiliated facility within the region (2010-first quarter 2017) within a single academic medical center in the Midwest United States were reviewed. Injury frequency and distribution by anatomic region were analyzed over time and with respect to age, gender, and BMI.

RESULTS: A total of 1031 individual Cross-fit related injuries were identified, 26% of which required multiple treatment encounters. The mean age was 36.8 (SD 11.2), BMI was 27.1 (SD 5.2), and there was equal representation of men (50.1%) and women (49.9%). The number of cross-fit related injuries has steadily increased with time at an average rate of 30% per year. The most common injuries involved the knee (24.2%) followed by shoulder (18.5%), spine (17.6%; 72% lumbar, 18% cervical, 10% thoracic), foot & ankle (12.4%), and hip (8.6%). Severe non-orthopedic sports injuries were rare (0.6%; 5 cases rhabdomyolysis, 1 case sudden cardiac arrest due to hypertrophic obstructive cardiomyopathy with successful resuscitation). Injury distribution has not changed with time from 2010-2017 and is unrelated to season. Shoulder-related injuries were more common in men (OR 1.64 CI 1.19, 2.26; $p=0.002$) and older patients (per year increase in age: OR 1.03 CI 1.01, 1.05; $p<0.001$) with an otherwise equal distribution of orthopaedic injuries by gender, age, and BMI.

DISCUSSION/CONCLUSIONS: Encounters for Crossfit-related orthopedic injuries have steadily increased with time as the sport continues to gain popularity. Severe non-orthopedic injuries in this sport are rare. Women may have higher injury incidence rates in this sport, as regional affiliate gyms have over 2/3 male athletes but equal numbers of male and female sports injuries were seen at our medical center. Spine, knee, and shoulder related injuries predominate, with little variation by year or season, though shoulder injuries were more prevalent in men and in older athletes.

Cyclops Lesions After ACL Reconstruction: Bone-Tendon-Bone Autograft Compared to Hamstring Autograft

Abstract ID: Paper 229

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INTRODUCTION: ACL reconstruction is commonly performed with either bone-tendon-bone autograft or hamstring autograft. Each of these options has inherent advantages and disadvantages that are well documented. However, to our knowledge, no study has compared the incidence of cyclops lesions between bone-tendon-bone autograft and hamstring autograft. By focusing on cyclops lesions, a source of knee extension loss following ACL reconstruction, our study aims to expand the comparison between these two autograft options.

METHODS: A single-center, retrospective review identified 1,909 patients between the ages of 8 and 66 years old treated with ACL reconstruction between January 1, 2000, and October 31, 2015. 1541 patients received a bone-tendon-bone autograft. 368 patients received a hamstring autograft. ACL reconstructions were performed by 19 different orthopedic surgeons. The incidence of cyclops lesions was confirmed by a second arthroscopy in patients treated for a loss of full knee extension.

RESULTS: Cyclops lesions occurred in 21 of 1541 (1.38%) bone-tendon-bone autografts and 5 of 363 (1.38%) hamstring autografts ($p=0.99$). Thus, there was no statistically significant difference. In fact, the incidence in this large patient study was essentially identical between the two groups. The 5 hamstring autografts with cyclops lesions were composed of 2 men and 3 women. The 21 bone-tendon-bone autografts with cyclops lesions were made up of 7 men and 14 women ($p=0.27$).

CONCLUSION: Bone-tendon-bone autografts and hamstring autografts continue to be viable options for ACL reconstruction. An increased incidence of cyclops lesions is a potential disadvantage that has not been previously compared between these two graft options. However, this study found no statistically significant difference in the incidence of cyclops lesions between the two groups ($p=0.99$), with an overall incidence of 1.38%. These results minimize any concern for an increased cyclops lesion risk when debating between bone-tendon-bone autograft and hamstring autograft.

Biomechanical Comparison of FiberTape vs. FiberWire Suture in Simulated Achilles Tendon Midsubstance Rupture

Abstract ID: Paper 230

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INTRODUCTION: As sutures have progressed in strength, increasing evidence supports the suture-tendon interface as the site where most tendon repairs fail. Suture tape has a larger surface area and has been hypothesized to decrease the amount of force per unit area on the tendon, allowing it to withstand greater loads to failure. This study compares the effects of suture tape (FiberTape) versus polyblend suture (FiberWire) at the suture-tendon interface in a sample of cadaveric Achilles tendons. The purpose of our study was to isolate the fixation method of the proximal tendon and to compare the biomechanical strength of two commonly used suture types.

METHODS: Eleven paired Achilles tendons were harvested and transected 4 centimeters proximal to the insertion at the calcaneus. The proximal portion of the Achilles tendon was then sutured using a running, locking Krackow repair with three throws on either side of the tendon. One tendon from each matched pair was sutured with 2 millimeter FiberTape and the other with a #2 FiberWire. All Achilles repair constructs were cyclically loaded on a servo pneumatic testing apparatus from 10 to 100 Newtons (N) at 2 hertz for 2000 cycles, after which they were loaded to failure at a rate of 0.83 millimeters per second. Suture footprint height before and after cyclic testing was recorded, as well as load to failure and method of failure.

RESULTS: Clinical load to failure for FiberTape was 290.4 ± 74.8 N, while FiberWire clinical load to failure was 231.7 ± 70.4 N ($p < 0.01$). Ultimate load to failure for FiberTape was 352.9 ± 108.1 N and FiberWire ultimate load to failure was 289.8 ± 53.7 N ($p > 0.05$). While cyclic testing showed changes in suture footprint height with cyclic loading, the results were not significant between the two groups. Although only observational, FiberTape failed more frequently at the knot (5 versus 2 with FiberWire) and FiberWire had more failures at the suture between the knot and tendon (4 versus 0 with FiberTape), while both had similar amounts of failure at the suture-tendon interface (6 with FiberTape versus 5 with FiberWire).

DISCUSSION: In biomechanical testing of matched cadaveric specimens, our results show that FiberTape performed better than FiberWire, with a significantly greater mean load to clinical failure. Thus, FiberTape will likely provide added repair strength in vivo for acute Achilles midsubstance rupture and may allow patients to begin earlier functional rehabilitation protocols.

Comorbidity Effect on Speed of Recovery After Arthroscopic Rotator Cuff Repair

Abstract ID: Paper 231

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INTRODUCTION: Recovery following rotator cuff repair has been shown to plateau at 1 year. Comorbidities are known to affect both rotator cuff healing and postoperative outcomes; however, the influence on the speed of recovery (SOR) following arthroscopic rotator cuff repair (RCR) remains largely unknown. The purpose of this study was to analyze the effect of comorbidities on the SOR and overall outcomes following RCR.

METHODS: An institutional shoulder surgery registry query identified 627 patients who underwent primary arthroscopic RCR from 2006-2015. Measured motion and patient reported outcome measures (PROMs) for pain and function were analyzed for preoperative, 3-month, 6-month, 1-year, and subsequent intervals. Plateau in maximal improvement was defined as the follow-up point at which no subsequent statistically significant improvement was observed when compared to the immediately preceding follow-up interval. Subgroup analysis of overall outcome and plateau in maximum improvement was performed based on the presence or absence of diabetes, smoking, obesity, hypercholesterolemia, and older age. Obesity was defined as BMI ≥ 30 kg/m² and older age was defined as > 65 years.

RESULTS: Preoperatively, 74 patients were noted to have diabetes (11.8%), 49 were smokers (7.8%), 200 had a BMI ≥ 30 (31.9%), 132 had hypercholesterolemia (21.1%), and 269 were greater than 65 years of age (43.9%). Diabetic patients had worse pain (VAS pain), functional outcome scores (ASES function, SST, and VAS function), and elevation at 6 months and 1 year ($p < 0.05$), with an earlier plateau in recovery (6 months) for nearly all variables. There were no significant differences between smokers and non-smokers for all variables following surgery; however plateaus occurred earlier in smokers (6 months). Obese patients had worse ASES function and external rotation (ER) at 1 year ($p < 0.05$) with similar plateau points. No significant differences were observed in outcomes for patients with hypercholesterolemia; however, plateaus for SANE and motion occurred earlier (at 6 months). Outcome scores for patients over 65 years were not significantly different from younger patients and plateaus occurred at 1 year for all variables except external rotation.

CONCLUSIONS: Diabetes most dramatically affected the speed of recovery following arthroscopic rotator cuff repair, with worse overall outcomes at earlier plateau points. Earlier plateaus were seen for smokers and for motion in obese patients. Obese patients showed lower overall functional scores and ER. Age did not influence the speed of recovery.

Implications of Core and Hip Injuries on Major League Baseball Pitchers on the Disabled List

Abstract ID: Paper 232

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PURPOSE: Investigate the frequency of core and hip injuries in MLB pitchers and their impact on performance, workload, and pitch type.

METHODS: Demographic, performance data, and injury data was acquired for 330 MLB pitchers with 454 injuries placed on the disabled list from 2014 to 2015 seasons. Core and hip/groin injuries were analyzed in which injury year data was compared to career data and against other injury groups.

RESULTS: Core injuries represented 14% of all injuries and hip/groin injuries represented 7%. Average days on the DL for core injuries were 47.0 (SE 5.6) days and 37.7 (SE 8.1) days for hip/groin injuries. Return from the DL the same season for core injuries was 78% and 73% for hip/groin injuries. Core injuries returned to the DL 46% of the time (73% for non-core injuries) and hip/groin returned 56% of the time (60% for non-hip/groin injuries). No changes in workload were noted except starters with core injuries pitched less innings/game (5.3 vs. 4.9 innings/game, $p=0.031$) and more pitches/game (85.5 vs. 78.4 pitches, $p=0.026$). Fastball velocity decreased in the core injury group the year of injury (91.6 vs. 92.2 mph, $p=0.001$). Core injuries had slightly fewer home runs/9 innings and fewer strikeouts/9 innings; hip/groin injuries had slightly more strikeouts/9 innings, with all other performance statistics no different between the groups including ERA and WAR.

CONCLUSION: Core and hip injuries in MLB pitchers result in similar time on the DL compared with other injuries. Pitching workload during the year of injury does not seem to have a significant impact on sustaining a core or hip injury. Although there is a high rate of return to play from the disabled list, there is a high rate of reinjury in these pitchers more often for other injuries.

Prevalence of Jones Fracture Repair and Impact on NFL Participation During NFL Rookie Season

Abstract ID: Paper 233

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BACKGROUND: Treatment of Jones fracture is challenging due to high rates of recurrent fracture, nonunion, and delayed union, particular in athletes. The purpose of this investigation was to evaluate: (1) the prevalence of Jones fracture fixation in elite American football athletes invited to the NFL Combine and (2) the impact of Jones fracture repair on NFL participation when compared to athletes with no history of Jones fracture repair.

METHODS: Athletes invited to the NFL Scouting Combine between 2012 and 2015 were evaluated for a history of surgical fixation for Jones fracture. Athlete position and surgical history were collected while radiographic and physical examination findings were recorded. Future participation in the NFL was evaluated based on draft status, regular season games played, and started in athlete's first season following the Combine. Participation was compared against all other athletes invited to the Combine without a history of Jones fracture repair. Continuous variables were analyzed using a student's t-test while categorical variables were analyzed using chi-square test.

RESULTS: Fixation was performed in a total of 41 fractures in 40 athletes (3.1%) invited to the NFL Combine between 2012 and 2015. The highest prevalence was in defensive linemen (n=10 athletes) and the greatest rate in tight-ends (5.1%, n=4 of 79 athletes). Fractures were treated with intramedullary screw fixation in 100% (n=41 fractures) of cases. Radiographically, 92% (n=38 fractures) of repairs had complete radiographic union across the fracture site while nonunion was appreciated in 8% (n=3 fractures) of fractures. A total of 70% (n=28) of athletes with a history of Jones Fracture repair were successfully drafted and were not at significant risk for going undrafted when compared to all other athletes (p=0.61). Comparison of athletes with fracture repair to those without repair found no significant difference in the number of games played (8.8 ± 6.8 games versus 7.4 ± 6.6 , respectively; p=0.23) or games started (3.0 ± 5.4 games versus 2.7 ± 4.7 games, respectively, p=0.76) during athletes' first NFL season.

CONCLUSION: Appropriate treatment of Jones fracture in elite American football athletes does not reduce NFL participation in the year following the Combine when compared to athletes with no history of Jones Fracture repair. Future prospective studies analyzing long-term outcomes in regards to fixation failure and impact on NFL performance and career length are warranted.

Summative Report on Time Out of Play for Major and Minor League Baseball: An Analysis of 49,955 Injuries from 2011 through 2016

Abstract ID: Paper 234

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BACKGROUND: Recent epidemiologic reports have suggested that injury rates are rising in Major League Baseball (MLB) and Minor League Baseball (MiLB). Although several studies have recently been published on specific injuries, the majority of injuries have not yet been formally studied. The primary purposes of this work were to (1) generate a summative analysis of all injuries that occur in MLB and MiLB, (2) identify the 50 most common injuries, and (3) generate focused reports and fact sheets on the characteristics of each of those diagnoses.

METHODS: The MLB Health and Injury Tracking System was used to identify injuries occurring in MLB and MiLB players from 2011 to 2016. Injuries were defined as those that occurred during normal baseball activity and resulted in at least one day out of play. A multitude of player and injury characteristics were analyzed, and detailed reports of the 50 most commonly occurring injuries were generated.

RESULTS: A total of 49,955 injuries occurred during the study period. 45,123 were non-season ending, and they resulted in 722,176 days out of play. The mean (median) days missed per injury was 16 (6) days. Pitchers were responsible for 39.1% of injuries. The upper extremity was involved in 39% of injuries while 35% occurred in the hip/groin/lower extremity. Surgery was required in 6.5% of cases and 9.7% of injuries were season ending. Hamstring strains were the most common injury (n=3,337) followed by: rotator cuff strain/tear (n=1,874), paralumbar muscle strain (n=1,313), biceps tendinitis (n=1,264), oblique strain (n=1,249), and elbow ulnar collateral ligament injury (n=1,191). The diagnoses that were most likely to end a player's season were elbow ulnar collateral ligament injury (60% season-ending) and superior labrum (SLAP) tear (50.9% season-ending).

CONCLUSIONS: Contrary to prior reports relying on disabled list data, the annual number of injuries in professional baseball remained steady from 2011 to 2016. Similar trends were noted for the annual number of days missed and mean days missed per injury. Although the mean days missed per injury was high (16 DM), the median was much lower at 6 days.

Age Over 40 Does Not Affect Meniscus Repair Failure Rates at Five Years

Abstract ID: Paper 235

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BACKGROUND: Meniscal tears are one of the most common orthopedic injuries and are increasingly being treated with surgical repair. Currently, there is no conclusive evidence regarding repair failure rate in the over 40 age group when compared to younger patients. The purpose of this study is to determine failure rates of the over 40 patient population compared to the under 40, and to present long-term clinical outcomes of both groups.

METHODS: A total of 476 patients underwent meniscus repair with a single surgeon with an average 5-year follow-up. Of the 476 patients, 73 patients were over 40 years of age (mean 46.77 years, SD 5.14) and 394 were under 40 (mean 24.03 years, SD 6.36). Failure of the meniscus repair was determined for each patient. Failure was defined as a meniscectomy, repeat meniscus repair, or TKA on the original surgically repaired meniscus. All had patient-reported outcomes in the form of IKDC, KOOS, and Marx scores. Risk of failure and average patient-reported outcomes due to age group were determined with logistic regression modelling after controlling for confounding variables including weight, sex, ACL status, number of implants utilized, tear pattern, and chondral status at the time of procedure.

RESULTS: The overall meniscus repair failure rate was 13% (61/467). Among patients less than 40 years of age the failure rate was 13% (51/394) and over 40 years of age was 14% (10/73). After adjusting for confounding variables, age over 40 was not associated with risk of meniscus repair failure (adjusted OR 1.13, 95% CI 0.51, 2.31; $p=0.74$). The older patient population progressed to failure more quickly, as the average time to failure for the over 40 age group was 14.91 months (SD 10.23) while the under 40 age group was 28.60 months (SD 23.42). On average, IKDC scores for the over 40 group age group (mean 63.76, SE 3.55) were significantly lower than those for the under 40 age group (mean 74.79, SE 2.50, $p=0.002$).

CONCLUSIONS: Patients greater than 40 years of age are not at increased risk of meniscus repair failure compared to patients under 40. In this population, IKDC and other outcomes scores may be lower than the younger population, indicating increased symptom severity despite equal failure rates.

Level of Evidence: II, prospective cohort study.

Key words: meniscus repair, over 40 years of age, failure rates

Prospective Short-Term Outcomes of Cryopreserved Osteochondral Allograft for Knee Cartilage Defects

Abstract ID: Paper 236

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INTRODUCTION: Cryopreserved osteochondral allograft is an emerging option for treatment of isolated, full-thickness cartilage defects of the knee, but there is a paucity of research analyzing patient outcomes following its use. The purpose of this preliminary study was to analyze the clinical outcomes, knee function, and activity level of patients after treatment of full-thickness cartilage defects of the knee with cryopreserved osteochondral allograft.

METHODS: Eighteen patients with full-thickness cartilage defects of the knee were treated with cryopreserved osteochondral allograft. The average age of the patients was 31 (15-45) years (6M: 12F). The patients were prospectively followed at baseline and postoperatively using validated clinical outcome measures including the Veterans RAND 12-item Health Survey (VR-12), International Knee Documentation Committee (IKDC), Knee Injury and Osteoarthritis Outcome Score (KOOS), and the Tegner activity scale.

RESULTS: The average patient BMI was 28.4 (18-38). The treated cartilage defects included 13 on the patella, 2 on the femoral trochlea, 2 on the lateral femoral condyle, and 1 on the medial femoral condyle. At an average follow-up of 17.7 (12-85) months, this group of patients demonstrated improvements in clinical outcome scores, knee function, and activity levels compared to baseline. Postoperatively, mean VR-12 scores increased from 27.4 to 42.4 ($p=0.029$), mean IKDC increased from 36.3 to 73.3 ($p<0.01$), mean KOOS increased from 48.6 to 76.4 ($p<0.01$), and mean Tegner scores increased from 2.7 to 4.2 ($p=0.071$). One patient with bipolar lesions went on to failure with progressive patellofemoral osteoarthritis and was ultimately converted to a patellofemoral arthroplasty.

DISCUSSION AND CONCLUSION: Preliminary findings from this prospective case series study suggests that patients with full-thickness cartilage defects of the knee can have positive short-term outcomes following surgical treatment with a cryopreserved osteochondral allograft. The one patient that failed treatment had a bipolar lesion which may be a contraindication to this treatment choice. To our knowledge, this is the first study evaluating the short-term outcomes in patients following treatment with cryopreserved osteochondral allograft. Longer-term outcomes are needed to assess its durability.

Assessment of Elbow Torque During the Pitching Motion: Which Has Higher Torque, the Fastball or Curveball?

Abstract ID: Paper 237

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BACKGROUND: Recently, a new device was introduced with the purpose of quantitatively measuring torque/workload across the medial elbow during the throwing motion. The purpose of our study was to assess the reliability of this device in detecting elbow torque during the pitching motion in competitive baseball pitchers, and to determine the differences in torque across pitch types.

METHODS: The sensor was positioned directly over the UCL and pitchers were instructed to throw 8 fastballs, 8 curveballs, and 8 change-ups in a standard, randomized sequence. The sensor reported elbow torque, arm speed, arm slot, and shoulder rotation while a radar gun measured peak ball velocity. Precision was calculated by measuring outlier rate, and mixed model regression analysis was performed to detect differences in throwing biomechanics among pitch types.

RESULTS: In total, 37 competitive baseball pitchers were included in the study. The device had a precision of 96.9% for fastballs, 96.9% for curveballs, and 97.9% for change-ups. The device was sensitive enough to distinguish pitches according to elbow torque, arm speed, arm slot, and shoulder rotation. Fastballs caused the greatest torque across the medial elbow (average = 45.56 Nm), compared to changeups (43.77 Nm; $p=0.006$) and curveballs (43.83 Nm; $p=0.01$).

CONCLUSION: The sensor is a reliable and reproducible device for measuring torque across the medial elbow, as well as additional parameters of arm speed, arm slot, and shoulder rotation. Torque was significantly higher in fastballs than curveballs and change-ups.

HAND

Buried vs. Exposed K-wires in Hand and Wrist Fractures: Systematic Review and Meta-Analysis

Abstract ID: Poster 001

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INTRODUCTION: Fractures of the hand and wrist are common injuries that account for 10-12% of all fractures. K-wire fixation is a common, inexpensive, and cost-effective treatment option for a many of these fractures. Despite the frequency of K-wire use in hand and wrist fractures, there is lack of consensus regarding optimal technique to prevent pin site complications. The purpose of our study was to perform a systematic review and meta-analysis comparing pin site infection and total complication rates in hand and wrist fractures treated with buried versus exposed K-wire fixation.

METHODS: The MEDLINE, EMBASE, and Cochrane Control Register of Controlled Trials databases were queried to identify potentially relevant publications, altogether yielding 537 unique studies. Two reviewers assessed each potential study against the inclusion criteria, coming to a consensus that 47 met inclusion criteria for systematic review and 5 for meta-analysis. For these studies, we performed data extraction relevant to primary outcomes, quality assessment for risk of bias, and Q statistic/I² calculations to assess heterogeneity of results. Meta-analysis using the R software was performed using a random-effects model. Statistical heterogeneity was assessed using a chi-square test with a p=0.05 threshold for significance.

RESULTS: Among the 14 studies with buried K-wires (658 fractures; 1,547 pins), 9 were of moderate-high quality. For the 35 studies that included exposed K-wires (1,787 fractures, 4,059 pins), 28 were of moderate-high quality. The pooled infection rate for buried K-wire fixation was 3.0% (range: 0-8.0%) with Q value of 5.3 and I² of 0%. The pooled infection rate for exposed K-wire fixation was 6.1% (range: 0-34.5%) with Q value of 51.9 and I² of 34.5%. The pooled total complication rate for buried and exposed K-wire fixation was 24.0% (range: 0-62.0%) and 18.6% (range: 0-57.9%), respectively. In sub-analysis of distal radius fractures (2,397 fractures) buried versus exposed technique yielded pin-site infection rates of 3.9% and 7.5%. In comparison, the pin-site infection rate among metacarpal/phalangeal fractures (198 fractures) was 3.8% for buried and 6.8% for exposed K-wires. Results of meta-analysis using a random-effects model demonstrated a non-significantly decreased pin-site infection rate in buried versus exposed K-wires (OR 0.40, CI: 0.16-1.01).

CONCLUSION: Our findings suggest a non-significant trend towards diminished pin site infection rates among buried compared to exposed K-wires in hand and wrist fractures.

Additional high quality studies evaluating pin site infections and complications of buried versus exposed K-wires are needed.

Fracture Severity Clinical Rank Ordering and Perceived Anatomic Fixation Difficulty Are Concordant with Distal Radius Fracture Energy Absorption

Abstract ID: Poster 002

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INTRODUCTION: Distal radius fractures comprises a spectrum of severity [1]. Existing classification systems have poor inter-rater reliability and ineptly describe the variation in severity [2]. In the lower extremity, energy absorption has been used to measure fracture severity and found to be predictive of post-traumatic OA (PTOA) [3-6]. These methods were adapted to intra-articular distal radius fractures. This study compares computed CT-based severity with clinical fracture severity on radiographs by hand surgeons.

METHODS: Following IRB approval, injury radiographs of 12 distal radius fractures of varied severity with a CT scan available were selected. Energy was calculated by measuring the fracture-liberated inter-fragmentary surface area using a validated technique [6]. Energy was obtained via bone density-dependent energy release. Three fellowship-trained hand surgeons ranked injury radiographs from least to most severe based on fracture severity and perceived difficulty of operative fixation.

Concordance rates were calculated among surgeons and between surgeons and the CT-based fracture energy by comparing ranked orderings. Rankings were concordant if one injury was more severe than the other in both ranking systems. A concordance rate was calculated by the concordant pairs divided by total possible pairings. The probability of agreement no better than chance was 0.5.

RESULTS: Energies ranged from 3.0 Joules (J) to 9.0J. The mean energy was 5.3J with a standard deviation of $\pm 2.0J$. Injuries were evenly distributed across the range of energies. Concordance between the three raters for severity averaged 86% and for difficulty of fixation averaged 69%.

Fracture energy ranking agreed with clinical severity ranking, with an average concordance rate of 69%, and with difficulty of anatomic fixation ranking, with an average concordance rate of 66%.

DISCUSSION AND CONCLUSION: Objective measures for determining the severity of bony injuries have widespread implications. Fracture energies may provide important prognostic data in the upper extremity that can aid in treatment decisions. CTs are not routinely obtained which could skew the severity. Calculated energies based upon the inter-fragmentary surface area for the distal radius were concordant with rankings of both severity and difficulty of anatomic fixation.

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Surface Replacing Arthroplasty for Metacarpophalangeal Joint Arthritis; A Comparison of Etiologies

Abstract ID: Poster 003

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HYPOTHESIS: There remains a paucity of studies examining surface replacing arthroplasty (SRA) in the treatment of pathologies of the MCP joint. The objective of this study was to assess the results MCP arthroplasty utilizing the SRA prosthesis for various surgical indications.

METHODS: Utilizing our institution's total joint registry, we performed an analysis of 76 primary MCP arthroplasties with the SRA prosthesis in 34 patients for osteoarthritis at our institution from 1998 to 2006. The mean age at surgery was 55 years, BMI 25, with 46% involving the dominant extremity, 80% females, 20% smokers, no laborers, and 3% with diabetes mellitus (DM). There were 61 patients with inflammatory arthritis, 10 with osteoarthritis (OA), and 5 with post-traumatic arthritis. The following are patient characteristics between the inflammatory arthritis, OA and post-traumatic groups: age (54, 61, 58), females (88%, 60%, 20%), and DM (3%, 0%, 0%).

RESULTS: There were 15 revision surgeries performed at a mean 3.1 years postoperatively, including 13 in patients with inflammatory arthritis and 2 in those with osteoarthritis. The 2, 5, and 10-year survival rates were 90%, 84%, and 74%, respectively. The 5-year survival rates for the inflammatory arthritis, OA, and post-traumatic arthritis were 84%, 73%, and 100% ($p=0.32$), respectively. Postoperative complications include 3 dislocations, but no infections, cases of heterotopic ossification or postoperative fractures. 33 (43%) of patients had recurrent ulnar deviation as determined by the surgeon clinically. There were no significant differences in the rate of dislocations between the surgical indications, but patients with inflammatory arthritis had higher rates of ulnar deviation ($p<0.01$). In those unrevised patients, at a mean 7.0 years (2-12) follow-up, preoperative to postoperative pain levels significantly improved ($p<0.01$). MCP total arc of motion slightly improved from 38° preoperatively to 51° postoperatively ($p=0.22$), while there was no significant change in grip or pinch strength ($p>0.19$). Total arc of motion was slightly decreased in the post-traumatic group (45° compared to the OA (50°) and inflammatory arthritis (60°) groups ($p=0.66$).

SUMMARY POINTS: MCP arthroplasty utilizing the SRA prosthesis is associated with reasonable medium-term survival and low complications. However, there is a high rate of recurrent ulnar deviation in patients with inflammatory arthritis. Patients experience predictable pain relief and slight improvements in their motion. SRA implants has the potential to be considered as an alternative prosthesis, especially in patients with post-traumatic or osteoarthritis.

Underutilization of Upper Extremity Reconstruction for Persons with Tetraplegia: The Patient Perspective

Abstract ID: Poster 004

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INTRODUCTION: Tetraplegia affects functional hand use. Previous studies have shown that 65% of persons with tetraplegia would benefit from upper extremity reconstruction, but fewer than 10% actually have the procedure performed. Prior studies have evaluated the reasons for underutilization of upper extremity reconstruction and have concluded that physician counseling, availability of surgeons to whom to refer, and several patient factors can influence patients' attitudes toward these procedures. This study aims to determine patient-perceived barriers to proceeding with operative intervention and, from this data, develop a tool to identify these barriers in an effort to enable providers to address common patient concerns.

METHODS: A telephone survey was administered to 30 persons with tetraplegia that had been referred to a tendon transfer clinic by physiatrists, were considered a surgical candidate, and declined to have the surgeries performed. Data was evaluated using a cluster analysis to sort individuals into groups to determine group similarities.

RESULTS: Four significant clusters were identified and given a name: (a) Conflicted, (b) Waiting for the Cure, (c) Too Costly, and (d) Lack of Understanding. Each group was found to have specific concerns that can be identified by practitioners to provide focused and relevant education on upper extremity reconstruction to these patients. Preoperative discussions with the "Conflicted" group can include assisting the patient in developing clear understanding of what is involved with the proposed procedures as well as their potential benefit. Patients in the "Waiting for a Cure" cluster need a better understanding of the risks and benefits of novel treatments being actively researched, but also information on what benefits they could see with the proposed upper extremity reconstruction. Education regarding the burden of recovery, time off of work that would be required, and the possible career gains that may be made as a result of improved hand function are points to address with the "Too Costly" cluster patients. A discussion with financial counseling at the facility may also be of utility. Finally, discussions with patients who fall in the "Lack of Understanding" cluster can focus on functional improvements, and possibly include peer-visitor contact and audiovisual aides to demonstrate functional improvements that can be seen postoperatively.

CONCLUSION: The results of this study provide a framework that can help guide practitioners to have a patient-centered discussion regarding options for upper extremity reconstruction in patients with tetraplegia, which may lead to increased utilization of tendon transfer procedures in this population.

Adventitial Cysts Associated with the Radial Artery

Abstract ID: Poster 005

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INTRODUCTION: Volar radial wrist masses are common with an exhaustive differential list. We describe a case series of adventitial cysts in association with the radial artery and detail its pathophysiology and treatment. It is an important diagnosis to be considered in the differential, given the impact on treatment and potential for complications if not prospectively recognized.

MATERIALS AND METHODS: We conducted an IRB-approved retrospective review of patients treated at our institution with adventitial cysts of the radial artery from 1997 to 2015. Their presenting symptoms, work-up, and treatment were detailed. All patients had at least one MRI.

RESULTS: Ten patients (six women and four men) with an average age of 50 years were identified over an 18-year period. Presenting symptoms included pain and swelling over the volar radial aspect of the wrist. High resolution magnetic resonance imaging (MRI) demonstrated tubular, cystic lesions within the adventitia of the radial artery with connections to the wrist joint confirmed on multiplanar imaging. Seven patients underwent operation, at which time the cyst was resected and the articular branch disconnected. These patients reported resolution of their symptoms without clinical recurrence. Three patients were treated non-operatively.

CONCLUSIONS: Adventitial cysts associated with the radial artery should be considered in the differential diagnosis of volar radial wrist masses. They can be readily diagnosed by preoperative MRI and the aberrant stalk communication to the wrist joint identified and subsequently targeted during operative treatment.

Keywords: adventitial cyst, radial artery, wrist mass
Level of evidence: IV

Treatment of Total Wrist Arthroplasty Dislocation; An Analysis of 38 Consecutive Cases

Abstract ID: Poster 006

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HYPOTHESIS: There remains a paucity of information regarding the treatment outcomes of dislocation after total wrist arthroplasties (TWA). This study's purpose was to assess the outcomes of surgical and nonoperative treatment modalities for TWA dislocations.

METHODS: Out of 445 primary TWA arthroplasties collected in a single institution's total joints registry over a 35-year period, there were 38 (9%) acute dislocations that required intervention by a healthcare professional. The mean age was 56 (35-74), with 31 (82%) females. The diagnoses for the TWA dislocations included rheumatoid arthritis (n=36) or osteoarthritis/post-traumatic arthritis (n=2). The study analyzed dislocation treatment, subsequent procedures needed, pain scores, and range of motion at last follow-up. Dislocation was defined as radiographic evidence of TWA prosthetic dislocation diagnosed and treated by a fellowship-trained hand surgeon.

RESULTS: Of the 38 dislocations, initial treatments included 31 closed reduction and splinting, 4 conversions to total wrist arthrodesis, and 3 soft tissue stabilization procedures involving open reduction and capsular tightening. Every patient initially treated nonoperatively or with soft tissue stabilization procedures alone failed management and experienced recurrent instability. Although 7 of these patients desired no further intervention, 22 patients treated nonoperatively and all 3 treated with soft tissue procedures eventually underwent revision TWA. Additionally, the other 2 treated nonoperatively were converted to arthrodesis. Ultimately, 6 patients underwent total wrist arthrodesis, while 25 underwent revision TWA. All 6 patients who underwent arthrodesis did not require further interventions, with none or mild pain at a mean 1.8 years (1-4) postoperative follow-up. Of the 25 revision TWAs, 5 (20%) experienced recurrent instability at a mean 3.6 months (1-14) postoperatively. At a mean follow-up 5 years (1-15), the 2- and 5-year survival-free of repeat instability after revision TWA for dislocation was 79% and 79%, respectively (Figure 1). No difference in repeat instability existed between the different implants utilized in the revision TWA ($p=0.87$). While a higher rate of repeat instability after revision TWA existed compared to fusion, it was not statistically significant ($p=0.12$).

SUMMARY POINTS: Treatment of TWA dislocation, while a rare event, is technically challenging, with high rates of repeat instability. Nonoperative and soft tissue stabilization procedures fail to restore wrist articular stability. While revision arthroplasty leads to stable joints in 4 out of 5 patients, our series suggests arthrodesis as the most reliable definitive treatment option for these patients.

FOOT AND ANKLE

Ankle Fusion in Patients with Chronic Hepatitis C: Complications and Mortality

Abstract ID: Poster 007

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PURPOSE: Chronic hepatitis C infection (HCV) affects between 3.4 and 4.4 million people in the United States and over 185 million people worldwide. As the survivability of those with HCV increases with advancements in antiviral therapy, these patients can expect to develop conditions about the ankle that may require ankle fusion. The purpose of this study is to identify inpatient, 30-, and 90-day outcomes following ankle fusion surgery in patients with HCV.

METHODS: The Healthcare Cost and Utilization Project State Inpatient Databases for California, Florida, Iowa, and New York were used to identify patients with HCV who underwent ankle fusion surgery 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: 7339 patients met inclusion criteria. Of these, 157 patients had a history of HCV. After matching these patients to non-Hepatitis C counterparts, the final analytic cohort was 157 in the HCV group and 381 in the non-HCV group. There were no statistically significant differences in overall complication rate between patients with HCV undergoing ankle fusion and those without HCV at any postoperative time point (inpatient, 30 days, or 90 days) ($p > .05$). Patients with history of HCV did not have an increased risk of surgical site infection, hemorrhage, or DVT/PE related complications at any time point compared to the non-HCV cohort ($p > .05$).

CONCLUSIONS: This is the first large study that investigates the complications and causes for readmission in patients with history of HCV who underwent ankle fusion surgery. Despite prior reports that patients with HCV are at elevated risk of postoperative complications after orthopedic lower extremity joint replacement surgery, this study found no significant increased risk for postoperative complications for patients undergoing ankle fusion. This study suggests a unique preoperative testing protocol in this patient population is unnecessary. Patients may be counseled that prior history of HCV alone may not predict inferior outcomes.

Deep Venous Thrombosis and Pulmonary Embolism After Lower Extremity Amputation in Patients with Diabetes

Abstract ID: Poster 008

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INTRODUCTION: Lower extremity amputations (LEA) and diabetes mellitus (DM) have both been associated with risk of deep venous thrombosis (DVT) and pulmonary embolism (PE). The aim of this study was to report the incidence and risk factors for DVT and PE in patients with DM using the American College of Surgeons National Surgical Quality Improvement Program® (ACS-NSQIP) database.

MATERIALS AND METHODS: Patients under the age of 90 with DM who underwent LEA between 2005 and 2015 were identified (n=23,380) from the ACS-NSQIP database.

RESULTS: The incidence of DVT and PE after LEA in 23,380 diabetic patients was 0.94% and 0.37% respectively. Neither age >65 years, BMI >30 kg/m² nor smoking status had a significant impact on the odds of DVT or PE. Additionally, diabetes management with insulin, non-insulin agents, and oral agents did not significantly predict or alter risk of postoperative DVT or PE. However, female sex was associated with 49% greater odds of DVT (OR 1.49, 95% CI: 1.15-1.95) and 64% greater odds of PE (OR 1.64, 95% CI: 1.08-2.51) after LEA. Presence of a prior history of myocardial infarction (MI) (OR 2.55, 95% CI: 1.45-4.50) or dialysis within two weeks of LEA (OR 1.52, 95% CI: 1.15-2.02) demonstrated significantly greater odds of DVT. However, PE was not associated with history of MI (OR 1.19, 95% CI: 0.37-3.85) or dialysis. One of the strongest predictors of DVT and PE was functional status before surgery. Patients who were functionally independent had 40% lower odds of DVT (OR 0.60, 95% CI: 0.46-0.79) and 48% lower odds of PE (OR 0.52, 95% CI: 0.34-0.80) than those with some level of functional dependence. In contrast, patients who were functionally completely dependent had 159% greater odds of DVT (OR 2.59, 95% CI: 1.81, 3.70) and 236% greater odds of PE (OR 3.36, 95% CI: 1.97-5.72) than those who were functionally independent.

DISCUSSION AND CONCLUSION: Female sex, history of MI, renal impairment, and poor functional status before LEA significantly increase odds of developing DVT. However, PE was only associated with female sex and poor functional status. No associations with DVT or PE were found with peripheral vascular disease or hypertension. Furthermore, type of glycemic control (insulin, non-insulin agents, or oral agents) did not significantly affect odds of perioperative thromboembolic events. Clinically, these findings may help determine risk of DVT and PE in diabetic patients undergoing LEA.

Hindfoot Moment Arm and Pes Planovalgus Radiographic Parameters in the Adult Acquired Flatfoot and Normal Patient Populations

Abstract ID: Poster 009

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INTRODUCTION: The use of the hindfoot moment arm in the radiographic assessment of pes planovalgus (flatfoot) deformity is well described in the literature and commonly used for surgical planning of deformity correction. No study to the authors' knowledge has investigated the relationship between the hindfoot moment arm and other common pes planovalgus radiographic parameters in both the normal patient population and those with pes planovalgus. This concept is important because in the setting of an increased hindfoot moment arm, the choice of surgical procedure for pes planovalgus deformity correction may change.

PUROPOSE: The purpose of the current study was to determine if there is a relationship between an increased hindfoot moment arm and a pes planovalgus deformity or a difference in hindfoot moment arm between pes planovalgus deformity and a control population.

MATERIALS AND METHODS: IRB approval was obtained. A retrospective chart review of 86 patients was performed from the senior author's clinical practice. Forty-three controls (no history of significant foot or ankle pain) as well as 43 patients with a clinical diagnosis of pes planovalgus deformity with complete foot, ankle, and hindfoot alignment radiographs of the affected were included. On the lateral radiographs, the talar-first metatarsal angle, calcaneal pitch, talocalcaneal angle, medial column height, calcaneal-fifth metatarsal height, and lateral column height was measured. The hindfoot moment arm was calculated on hindfoot alignment radiograph. On the AP radiographs, talar-first metatarsal angle and talar head uncoverage was measured.

RESULTS: Forty-three patient with pes planovalgus deformity and 43 normal patients were identified. There was a statistically significant difference between the pes planovalgus and control groups with respect to the talar-first metatarsal angle, calcaneal pitch, talocalcaneal angle, medial column height, calcaneal-fifth metatarsal angle, and hindfoot moment arm ($p < 0.001$, < 0.001 , 0.012 , < 0.001 , < 0.001 , < 0.001 respectively). The medial column height was correlated most strongly to the hindfoot moment arm (R squared – 0.48).

CONCLUSIONS: This study showed a statistically significant difference between patients with pes planovalgus group and a normal patient population with respect to the talar-first metatarsal angle, calcaneal pitch, talocalcaneal angle, medial column height, calcaneal-fifth metatarsal angle, and hindfoot moment arm. The clinical significance of this study is that in the setting of a pes planovalgus deformity, the clinician should consider obtaining a bilateral hindfoot alignment view in order to quantify the hindfoot deformity and ensure that the planned surgical procedure can correct the deformity.

Gastrocnemius Contracture in Patients with Rheumatoid Arthritis

Abstract ID: Poster 010

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INTRODUCTION: Rheumatoid arthritis is a chronic disease affecting multiple joints of the body, with more than 90% of patients developing foot or ankle pain over the course of the disease. Prior studies in non-rheumatoid patients have demonstrated an association between an isolated gastrocnemius contracture (lack of ankle dorsiflexion) and foot and ankle pain. To date, no study has measured ankle range of motion in rheumatoid arthritis patients in a validated manner. The purpose of the current study is to report ankle dorsiflexion in rheumatoid arthritis patients as well as a control group utilizing a validated measurement instrument. Our hypothesis was that patients with rheumatoid arthritis would have similar measured ankle range of motion to controls.

METHODS: Institutional review board approval was obtained and a prospective case-control study was performed. We utilized a previously validated device to measure ankle range motion and isolated gastrocnemius contracture in 70 patients diagnosed with rheumatoid arthritis as well as 70 controls. The measurements were repeated three times with the knee extended to isolate the effect of the gastrocnemius muscle. We additionally performed a clinical examination and goniometer measurement of ankle range of motion. Patient history, severity of rheumatism, and demographics were also obtained.

RESULTS: The rheumatoid arthritis group had a mean dorsiflexion of 12.3 degrees compared to a mean of 17.3 degrees in the control group with the knee extended, a statistically significant difference ($p < 0.001$). The device was used three times on each patient with no significant difference between measurements, ($p > 0.05$). The difference in dorsiflexion was significantly less utilizing a goniometer than using the validated device, which may be due to measurement technique and external landmarks ($p = 0.008$).

CONCLUSION: Patients with rheumatoid arthritis had less ankle dorsiflexion than the control group with the knee extended. This is the first, and largest, study investigating ankle range of motion in patients with rheumatoid arthritis utilizing a validated measurement device as well as a control group. The clinical significance of this study is that it provides evidence that patients with rheumatoid arthritis have decreased ankle dorsiflexion despite a lack of foot and ankle pain. In light of the high lifetime incidence of foot and ankle pain in the rheumatoid arthritis population and previous studies which demonstrate decreased ankle dorsiflexion in patients with foot and ankle pain, this study provides some evidence that the decreased ankle dorsiflexion may be a contributing factor in foot and ankle pain, but further studies are needed.

Cost Analysis: How to Optimize Profitability of Surgical Treatment Ankle Fractures in a Major Metropolitan Health System

Abstract ID: Poster 011

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INTRODUCTION: As the incidence of ankle fractures is increasing and surgical management has been demonstrated to be an overall successful modality of treatment, it is more relevant than ever for orthopedic surgeons to consider cost effectiveness of surgical fixation for ankle fractures.

METHODS: A retrospective cost analysis was performed utilizing value analysis team (VAT) data from 2010-2014 for two hospital sites within a large metropolitan hospital system. Cost and profit metrics were analyzed against surgeon subspecialty, surgeon volume, implant cost, CPT coding, hospital site, and length of stay.

RESULTS: VAT data identified 1542 operative ankle fractures, with the majority at hospital site 1 (78%) and an overall contribution positive margin (\$4665). Majority of direct costs (42%) were accounted for by implant cost (\$2565) and hospital site significantly affected contribution margin (\$5260 vs. \$2573, $p<0.001$). Length of stay had significant correlation with total indirect cost ($p<0.001$). Individual surgeons had significant differences in cost metrics between them ($p<0.05$). CPT code analysis demonstrated increased costs with more significant differences due to hospital site, surgeon volume, and implant costs for trimalleolar fractures compared to bimalleolar and unimalleolar fractures ($p<0.05$).

DISCUSSION AND CONCLUSIONS: Our data demonstrates that profitability of surgical treatment of ankle fractures can be maximized via careful selection of site of surgery, surgeon volume, and implant selection, especially for increased severity with trimalleolar fractures. It may also be less costly to perform ankle fracture fixation in outpatient surgery centers to decrease overall indirect costs. Increased awareness of CPT coding at the level of the surgeon may also lead to enhanced profitability.

Gastrocnemius Recession Provides Good Pain Relief, Increased Foot Function, and Satisfaction for Patients with Plantar Fibromatosis and Associated Gastrocnemius Equinus Contracture

Abstract ID: Poster 012

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INTRODUCTION: In patients who fail conservative treatment of plantar fibromatosis, surgical options include subtotal or complete plantar fasciectomy. These procedures have a high rate of recurrence and complications, however. Additionally, isolated gastrocnemius equinus contracture has been associated with midfoot and forefoot symptoms. Therefore, we hypothesize that patients with symptomatic plantar fibromatosis and concomitant gastrocnemius equinus contracture will have significant pain relief and satisfaction with an isolated gastrocnemius recession.

METHODS: We retrospectively reviewed eight patients who underwent nine isolated gastrocnemius recession procedures for symptomatic plantar fibromatosis after failing conservative treatment measures. This was a single institution cohort study with three different surgeons between 2012 and 2014. The clinical outcome measures were pain (visual analog scale scores), American Orthopaedic Foot & Ankle Society (AOFAS) scores, and overall patient satisfaction.

RESULTS: The average age of patients was 48 years (range, 21-69) with a mean follow up of 393 days. Average body mass index was 30.32. Mean preoperative and postoperative VAS scores were 5.6 and 2.1, respectively. Mean preoperative and postoperative AOFAS scores were 64.2 and 86.0, respectively. Seven of eight (87.5%) patients were highly satisfied with the outcome of the surgery. One patient underwent bilateral gastrocnemius recessions for bilateral plantar fibromatosis. One patient that was unsatisfied went on to plantar fasciectomy and was still unsatisfied with their overall result. No complications were encountered.

CONCLUSION: An isolated gastrocnemius recession can provide pain relief, increased foot function, and high satisfaction for patients with plantar fibromatosis and associated gastrocnemius equinus contracture.

PEDIATRICS

Developmental Pattern of the Greater Trochanter in Skeletally Immature Patients

Abstract ID: Poster 014

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BACKGROUND: Trochanteric entry antegrade nailing of pediatric patients allows for expanded options of internal lengthening and osteotomy in children, and has become increasingly accepted in patients aged 8 years and older despite violation of the active growth plate. The purpose of this study was to measure the height of the bony greater trochanter and its overlying cartilaginous cap during growth to provide normative means in predicting the amount of remaining growth, in order determine when the majority of greater trochanteric growth has occurred.

METHODS: Measurements of bony greater trochanter height were performed using annual longitudinally collected radiographs (ages, 6 to 14) from the Bolton-Brush collection (n= 335 radiographs from 45 patients, n=26 females, n=19 males). Magnetic resonance images (MRI) in patients between 6 to 14 years of age from the senior author's practice (n=55 scans in 55 patients, n= 29 males, n=26 females) were used to measure greater trochanter bony height and cartilage cap height. Greater trochanter height on was defined as the distance between the lateral base of the greater trochanter and tip of the bony greater trochanter, measured perpendicular to the anatomic axis of the femur on radiographs. Cartilage cap height was measured on MRI using identical methods. Inter-observer reliability was tested for using intraclass correlation coefficient, while differences between sexes were compared using a paired t-test.

RESULTS: Subjects from the Bolton-Brush collection had a mean of 6.6 ± 2.0 annual serial radiographs between the ages of 6 and 14, while subjects with MRI had a mean age of 9.9 ± 2.7 years. No significant differences in bony greater trochanter height were appreciated between males and females on radiographs versus MRI at any age. The greater trochanter appears to stabilize in both males and females around age 10. Cartilage cap height began to decrease substantially by age 7 in both males and females, disappearing on MRI by age 10 in females and age 11 in males.

CONCLUSIONS: Insertion of an intramedullary nail through the greater trochanter appears to be safe after age 7 following cessation of growth of the cartilage cap, while the greater trochanter continues to grow until age 10 in males and females. This study provides the first anatomic investigation demonstrating development of the greater trochanter during growth.

Pediatric Sports Medicine, A Growing Subspecialty in Orthopedics: An Analysis of the Surgical Volume of Applicants for the American Board of Orthopaedic Surgery Part II Certification Exam Over the Past Decade

Abstract ID: Poster 015

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INTRODUCTION: Pediatric orthopedic surgery has become increasingly subspecialized over the past decade. The purpose of this study is to analyze the volume of pediatric sports medicine cases performed by surgeons applying for the American Board of Orthopaedic Surgeons (ABOS) Part II certification exam over the past decade, comparing caseloads according to the type(s) of fellowship completed.

METHODS: The ABOS database was reviewed for all surgeons applying for the ABOS Part II certification exam from 2004 to 2014. Fellowship training of the applicants was recorded as Peds, Sports, or Dual-Fellowship (fellowship in both Peds and Sports). All other applicants were categorized as 'Other'. A total of 102,424 pediatric cases (patients <18 years old) were reviewed to identify sports medicine cases performed by CPT code. Multiple linear regression and Mann-Whitney-U tests were used to determine trends in case volume overall and according to fellowship training for all patients, patients ≥ 13 and patients <13. One-way ANOVA testing was used to compare multiple means followed by multiple post-hoc comparisons using a Tukey allpairwise approach using SPSS.

RESULTS: A total of 14,636 pediatric sports medicine cases were performed. There was an increase in the number of sports medicine cases performed in patients <13 (117.5 ± 31.8 from 2004-2009 to 212.4 ± 70.1 from 2010-2014, $p=0.035$; $r^2=0.743$, $p=0.0007$). The number of Peds ($r^2=0.601$, $p=0.005$), Sports ($r^2=0.741$, $p=0.0007$), and Dual-Fellowship applicants increased ($r^2=0.600$, $p=0.005$). Dual-Fellowship surgeons currently perform 21.4% of pediatric sports medicine cases compared to 2.1% in 2004 (919% increase). As a group, the number of pediatric sports cases performed by Dual-Fellowship ($r^2=0.630$, $p=0.004$) and Sports ($r^2=0.567$, $p=0.007$) applicants has increased, while the number performed by 'Other' applicants has decreased ($r^2=0.758$, $p=0.0005$). Per surgeon, Dual-Fellowship applicants performed a greater number of pediatric sports cases per year (36.5 ± 9.18) than Peds (6.71 ± 0.94), Sports (5.99 ± 0.46), and 'Other' (1.21 ± 0.15 , $p<0.0001$ for each) applicants from 2004-2014. Per surgeon, Dual-Fellowship applicants also performed more cases per year in each age group (22.4 ± 6.15 in age ≥ 13 and 14.3 ± 4.03 in age <13, $p<0.0001$ for each). Per surgeon, 'Other' applications had a decrease in the number of pediatric sports cases ($r^2=0.540$, $p=0.001$). 11,913 cases (81.4%) involved the knee, with results similar to cases overall.

DISCUSSION: ABOS Part 2 applicants who completed fellowships in both Sports and Peds have performed an increased number of pediatric sports medicine cases over the past decade.

Per surgeon, dual-fellowship-trained applicants have performed a markedly higher number of pediatric sports medicine cases compared to all other applicants.

Blood Transfusions in Posterior Spinal Fusions for the Treatment of Idiopathic Scoliosis

Abstract ID: Poster 016

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INTRODUCTION: Posterior spinal fusion (PSF) for the treatment of idiopathic scoliosis (IS) is associated with significant blood loss, but the need for transfusions has declined. Transfusion guidelines vary by institution and by national associations. The purpose of this study is to identify any patient or surgical factors that increase the need for transfusion, determine if preoperative type and cross is necessary, and evaluate the transfusion protocol at a single institution for safety and cost effectiveness.

METHODS: An IRB approved retrospective chart review identified 100 posterior instrumented spinal fusion cases for the treatment of idiopathic scoliosis by 5 orthopedic surgeons meeting inclusion criteria at a single institution over two years. Chart and radiographic data were reviewed. Main measures recorded include transfusions given, hemoglobin (Hb) levels, type and screen/cross, and volume status parameters. Surgical factors studied include levels fused, curve magnitude, Ponte osteotomies, estimated blood loss, cell saver use, surgeon, and time of surgery. Patient factors studied included the American Society of Anesthesiologists (ASA) score, BMI, age, and gender. Various statistical methods were used to analyze the data with $p < 0.05$ considered significant.

RESULTS: Of the 100 patients included, 11% received a perioperative transfusion, 6 intraoperatively and 5 postoperatively. Significant variation in transfusion rates amongst the 5 surgeons existed, ranging from 0 to 29%. Statistically significant risk factors for transfusion include a larger curve, increased levels fused, Ponte osteotomies, unstable hemodynamic parameters, and increased ASA scores. Type and screen was obtained in 100% of patients and a type and cross was obtained in 96%. According to our hospital's guidelines, 37% of cases warranted a transfusion, but was not given. In 3% of cases, transfusion recommendations were not met, but a transfusion was given. The main trigger for transfusion appeared to be Hb levels.

DISCUSSION AND CONCLUSION: In our study population, patients with an ASA greater than two, scoliotic curves greater than 75 degrees, and increased number of Ponte osteotomies led to higher transfusion rates. With a rather low transfusion rate of 11%, it may not be necessary to require a type and cross prior to surgery in all patients, only those at higher risk. Our institution's guidelines appeared to be inclusive and safe. This allowed the clinician to make the determination on whether a transfusion was appropriate or not. However, since hemoglobin was the main trigger for transfusion, considering a lower hemoglobin cutoff may be just as safe.

Planned Fibular Nonunion for the Treatment of Genu Varum in Achondroplasia: Results Through Skeletal Maturity

Abstract ID: Poster 017

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INTRODUCTION: Clinical manifestations of achondroplasia often include genu varum, but the exact etiology of this manifestation is unknown. Current surgical treatment options include tibial and fibular osteotomy and growth modulation by plates and screws. Frustrated by the results with these techniques, a single surgeon began performing a planned fibular nonunion (PFN) with the belief that fibular overgrowth was the main contributing factor. The purpose of this study is to describe this pediatric technique and report the clinical and radiographic outcomes through skeletal maturity.

METHODS: An IRB-approved retrospective study identified 53 limbs in 27 achondroplasia patients treated with PFN meeting inclusion criteria. About one-half had available pre- and/or post-surgery radiographs. The surgery included meticulous closure of the fibular bone. Clinically, lower limb alignment was assessed using a plumb line and six categories of alignment, ranging from extreme varus to extreme valgus. Radiographic measurements included the anatomic tibio-femoral angle (aTFA), tibia varus, mechanical zone, and tibia-fibula ratio. A failed surgery was defined as one requiring subsequent tibial or fibular surgery or clinically moving into a more varus alignment. Various statistical methods were used, with $p < 0.05$ considered significant.

RESULTS: Of the 53 PFN cases included in the study, 77% did not require subsequent tibia or fibular surgery. The average age at surgery and follow-up was 6.1 and 17.0 years, respectively. Clinically, 62% of the cases demonstrated improvement by moving into a more valgus alignment, 15% remained the same, and 23% were considered failures. Average radiographic measurements also improved pre- to post-surgery, including aTFA (3° varus to 6° valgus), tibia varus (2° varus to 5° valgus), the mechanical zone (-0.7 to -0.2), and the tibia-fibula ratio (0.977 to 1.013). At last radiographic examination, nonunion was maintained in 88% of the successful cases. Complications were minimal.

DISCUSSION AND CONCLUSION: This is the first study to demonstrate that PFN improved genu varum in achondroplasia patients and was maintained through skeletal maturity. The increase in the tibia-fibula ratio post-surgery suggests that fibular overgrowth may have contributed to the genu varum. PFN for the treatment of genu varum in young achondroplasia patients appears promising with relatively few risks.

Significant Reductions in Surgical Site Infection (SSI) in Spinal Fusion Patients Using a Bundled Intervention Approach

Abstract ID: Poster 018

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PURPOSE: Surgical site infection (SSI) following clean spinal fusion surgery leads to high morbidity and cost to the patient. The Center for Disease Control and Prevention cites that adoption and implementation of evidenced-based practices, such as bundled interventions, can significantly decrease surgical site infection rates. Wide clinical care variations likely contributed to the spine infection rates at our institution. The purpose of this quality value safety initiative (QVSI) was to reduce spine SSI meeting acute hospital acquired infection (HAI) criteria by 50% by the end of 2016.

METHODS: In 2016, a multidisciplinary SSI executive committee was created that included representation from a Physician Champion, Nursing, Administration, and Infection Prevention and Quality. A literature review was performed and evidenced based bundled interventions were implemented. Sequential Plan-Do-Study-Act cycles were implemented. The executive committee reviewed the prospectively collected data for all spine infections during 2 distinct study periods. Study Period #1: (7/1/2014 – 6/30/15) and Study Period #2: (7/1/2015 – 6/30/2016). Rapid cycle improvement strategies were initiated (as seen below).

2015

- Cycle #1 – Increased Ancef dosing from 25 mg/kg to 30mg/kg on all spine procedures
- Cycle #2 – Vancomycin and Gentamycin placed in the bone graft for neuromuscular/syndromic spine procedures
- Cycle #3 – Timing of pre-incisional iv antibiotics within 60 minutes of incision

2016

- Cycle #1 – Implemented a pre-operative Chlorhexidine (CHG) skin cleansing protocol
- Cycle #2 – Aligned timing of pre-incisional iv antibiotics to co-inside with intra-op sterile CHG site prep
- Cycle #3 – Re-dosing of Ancef every 3 hours - Cycle #4 – 24” Sterile Safe Zone around the OR table - Cycle #5 – Limit OR traffic

Root Cause Analysis was performed for infections meeting HAI criteria, and infection rates were calculated using rolling 6 months averages.

RESULTS: SSI rates for spinal fusion patients were effectively reduced from 11/304 = 3.61/100 in study period #1 to 5/322 = 1.50/100 in study period #2, with an overall 58% improvement, as well as a 60% reduction in direct cost to the patient.

CONCLUSION: We achieved our aims through the utilization of a multidisciplinary team, standardized bundle interventions, patient and family education, and root cause analysis methodology. We are planning to implement a standardized surgical/clinical pathway for the neuromuscular/syndromic spine population(s) by the end of 2017.

SIGNIFICANCE: The utilization of an evidence-based bundled intervention approach significantly reduced our spine infection rate by 58% and direct costs by 60%.

Increased Likelihood of Pediatric Recurrent Patellar Dislocations Based on Severity of Radiographic Measures

Abstract ID: Poster 019

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INTRODUCTION: The etiology for recurrent patellar dislocations in a child with patellofemoral instability (PFI) is not always clearly established. Radiographic measures help guide the clinician; however, there is paucity in the literature regarding “normal” and “pathologic” measures and the significance based on severity. There is also uncertainty regarding the parameters for identification of pathologic instability. The purpose of this study is to compare common imaging measures for PFI in a non-pathologic and known patellar dislocation pediatric population and determine the likelihood of symptoms based on the severity of each individual measure.

METHODS: An IRB-approved retrospective review of knee MRIs and radiographs at a single pediatric institution identified 108 limbs (102 patients) meeting inclusion criteria. Sixty-nine limbs had no known patellar pathology (control group) and 39 had surgery for recurrent patellar dislocations (surgical group). MRI measures included tibial tuberosity-trochlear groove distance (TT-TG), tibial tuberosity-posterior cruciate ligament distance (TT-PCL), and lateral trochlear inclination (LTI). Radiographic measures included the Caton-Deschamps Index (CDI) and Insall-Salvati Index (ISI). These measures are representative of PFI risk factors, specifically patellar tendon malalignment, trochlear dysplasia, and patella alta. Binomial logistic regression was used to relate the anatomical parameters to the probability of PFI.

RESULTS: The surgical and control groups were similar in terms of age, height and weight. The logistic regression analysis indicated that the TT-TG ($p=0.001$) and LTI ($p<0.001$) were correlated with PFI. The odds ratio (95% confidence interval) was 1.19 (1.07-1.31) for TT-TG, giving the increased probability of a knee to experience PFI for each 1 mm increase. The odds ratio was 0.85 (0.77-0.93) for LTI, showing a decrease in the probability of instability with each 1° increase. Neither CDI nor ISI measures significantly correlated with probability of PFI ($p=0.30$ and $p=0.18$, respectively). The two parameters of TT-TG and LTI accounted for 42% (Nagelkerke R^2) of the variance between the control and instability groups.

DISCUSSION AND CONCLUSION: This study suggests that the likelihood of pediatric PFI is dependent on the severity of the abnormal imaging parameters, specifically those representing degree of patellar tendon alignment and trochlear dysplasia. Children make up a significant portion of patients with recurrent patella dislocations requiring surgical correction. Determining the risk of recurrent PFI based on an abnormal parameter for a specific anatomic pathology would not only be helpful in deciding when to perform surgery, but also which procedure would best address the reason for instability.

Postoperative Oxygen Consumption: Growing Rod Graduates vs. Adolescent Idiopathic Scoliosis

Abstract ID: Poster 020

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PURPOSE: Growing Rod Graduates (GRG) are patients with EOS who are ≥ 3 years from surgical application of a growth friendly construct and have undergone a definitive spinal fusion, or are at least 1 year from their last lengthening. The purpose of this study was to compare the metabolic oxygen consumption and functional outcomes of GRG patients to patients with AIS that underwent posterior spinal fusion (PSF) with instrumentation ≥ 2 years prior.

The hypothesis was that post-fusion AIS patients would have better functional ability with less oxygen consumption during exercise than GRG patients.

METHODS: This is a retrospective review of prospectively collected data. Cohort 1 contained AIS patients who underwent PSF ≥ 2 years prior. Cohort 2 was GRG patients. PFTs were conducted, and measurements included FVC and FEV1. Metabolic testing was conducted via a submaximal graded exercise test on a treadmill. The patients who were able to reach $85\% \pm 5\%$ of their maximum predicted heart rate ($220 - \text{age}$) were included.

RESULTS: 42 AIS and 12 GRG patients participated. The primary diagnoses for the GRG patients were: congenital (6), syndromic (2), neuromuscular (1), and infantile idiopathic scoliosis (3). The average age at index surgery was 5.3 years (1.3-8.3 years), and the average follow-up from the initial surgical application of the growth friendly spine construct was 7.1 years (3.7-10.4 years). Their curve magnitude improved from an average of 85.9° to 44.2° in the frontal plane, and from an average of 58.9° to 52.8° in the sagittal plane. The 42 AIS patients were an average age of 12.6 years (10.2- 15.2 years) at the time of PSF with instrumentation and an average 2.6 years (2.0 – 3.3 years) from definitive fusion. Their frontal plane was corrected from 59.7° to 26.6° , and in the sagittal plane the deformity was improved from 23.9° to 32.9° .

PFTs were significantly better in the AIS cohort: average FVC% 82.2 vs. 45.5 ($p < 0.001$). 37/42 (88%) of AIS patients and 9/12 (75%) of GRG were able to complete the 85% of predicted maximal protocol. In the final stage of the treadmill test, GRG patients had a higher breathing rate while total volume and ventilation were significantly lower compared to AIS patient ($p < 0.05$).

CONCLUSION: Despite significantly lower PFTs, the majority of the EOS patients (75%) were able to complete the 85% predicted maximal testing. This indicates that these patients have the capacity to perform aerobic exercise.

Is the Pediatric Early Warning Score (PEWS) an Effective Tool After Posterior Spinal Fusion for Idiopathic Scoliosis?

Abstract ID: Poster 021

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INTRODUCTION: The modified Brighton PEWS is an age-based algorithm intended to help identify children at risk for impending deterioration, so that by early recognition and intervention, additional morbidity can be avoided, including the need for medical codes or transfers to the ICU. Scores range from 0-11, and are calculated based on five clinical assessments including behavior, cardiovascular status, respiratory status, nebulizer use, and emesis. This is the first study to examine the utility of PEWS following posterior spinal fusion in patients with idiopathic scoliosis.

METHODS: An IRB-approved retrospective review identified 95 idiopathic scoliosis patients that underwent posterior spinal fusion at a single institution from January 2014 to March 2016, which met inclusion criteria. PEWS were calculated for all patients following their surgery and throughout their hospital stay. Data was collected and analyzed for each case examining the maximum PEWS, including which components of the score were most commonly elevated in these postoperative patients, as well as the number of nursing communications for both PEWS and non-PEWS related events. The reason for the nursing call to the orthopedic team as well as if any action was taken, was also recorded.

RESULTS: Approximately 10% of patients had a PEWS of 5 or more, signifying they were at "high risk for deterioration" per the modified Brighton PEWS criteria. None of the patients required transfer to the ICU or evaluation by a medical response team. The most common elements that led to an elevated PEWS included cardiovascular and respiratory status. Only 10% of all the nursing notifications required by the PEWS protocol were felt to require some type of medical action. Of the nursing notifications that were not required per PEWS protocol, 51% resulted in some type of medical action.

DISCUSSION AND CONCLUSION: This is the first study to review the effectiveness of PEWS in patients having undergone posterior spinal instrumented fusion for idiopathic scoliosis. It would appear that PEWS overestimates the risk for impending deterioration in these otherwise healthy patients. Alternate measures or modifying the PEWS to reflect the normal physiologic changes secondary to surgery may reduce unnecessary calls and better identify patients at risk in this population. Evaluating the applicability of various outcome measures is important because many hospital systems are trying to apply a single scoring system across differing patient populations.

Proximal Humeral Physeal Closure Patterns Correlate with Skeletal Age

Abstract ID: Poster 022

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INTRODUCTION: The clavicle is the most frequently fractured bone in pediatric patients, with a bimodal distribution and a second peak between ages 13 and 15. As 80% of the clavicle's growth is completed by age 9 in females and 12 in males, remodeling potential in adolescent patients may be limited following fracture. While chronologic age can be used to infer a patient's remodeling potential, it may be an inaccurate indicator on which to base treatment. Currently, determination of skeletal age requires a hand radiograph, adding cost and radiation. The status of the proximal humeral physis may allow for estimation of skeletal age without requiring a separate hand radiograph. The purpose of this study is to examine the patterns of closure of the proximal humeral physis in adolescent patients.

METHODS: Patients between ages 9 and 18 undergoing shoulder radiographs and hand radiographs within 24 months were identified in our institutional database. Patients with endocrine disorders affecting growth, or fractures or tumors involving the proximal humeral physis were excluded. Shoulder radiographs with a true AP projection utilized. The status of the lateral (L) and medial (M) aspect of the proximal humeral physis was graded by two independent reviewers as (0) open, (1) closing, (2) nearly closed, or (3) completely closed. Skeletal age was determined with hand radiographs using the standards of Greulich and Pyle by a radiologist. Mean chronological and skeletal ages with 95% confidence intervals for each physeal closure pattern were calculated. The chronological and skeletal ages for each physeal closure pattern were compared via one-way ANOVA.

RESULTS: Overall, 154 patients (70.8% males; 29.2% females) met inclusion criteria, with mean chronological age of 13.3 ± 2.3 and mean skeletal age of 13.6 ± 2.5 . The skeletal age differed from the chronological age by one year or more in 25% of cases. In all cases, the medial physeal status was equal to or more advanced than the lateral physeal status. Skeletal age was different between each lateral physeal closure status (L0-L3, all $p < 0.022$) and medial physeal closure status (M0-M3, all $p < 0.011$). Seven distinct proximal humeral physeal closure patterns were observed.

DISCUSSION: We demonstrate a predictable pattern of closure of the proximal humeral physis in adolescent patients in which the medial aspect of the physis closes before the lateral physis, with seven distinct physeal closure patterns correlating with skeletal age. These findings may allow for determination of a patient's skeletal age without obtaining a separate hand radiograph.

Insufficiency Fractures of the Vertebral Column: A Review and Analysis of the American Orthopaedic Association's Own the Bone Database

Abstract ID: Poster 023

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BACKGROUND: Vertebral compression fractures (VCF) are the most common fragility fracture. In this study, the Own the Bone (OTB) program registry was utilized to (1) compare fracture-specific risk factors between patients with VCFs versus patients with other sites of insufficiency fracture (i.e., proximal femur, humerus, distal radius, etc.), and (2) compare differences in treatment recommendation and initiation rates between these cohorts.

METHODS: This study utilized the Own the Bone (OTB) program registry containing prospectively obtained data on 35,039 unique cases of fragility fracture--the largest registry of its kind. Spine fractures accounted for 3900 (11.1%) of the presenting fractures at OTB enrollment.

RESULTS: Multiple factors contributed to the risk of osteoporotic VCF. The most significant was a history of previous spine fracture (OR 8.01, $p < 0.001$). Those presenting on bisphosphonates were at greater risk (OR 1.55, $p < 0.001$). Patients with the "terrible triad" were 9% more likely (OR 1.09, $p = 0.03$) and those with vitamin D deficiency were 16% more likely (1.16, $p < 0.001$) to have a vertebral insufficiency fracture compared to other types of osteoporotic fractures. Overall, patients with a spine fracture were more likely to have treatment recommended (OR 1.81, $p < 0.001$) and to have treatment initiated compared to other fracture types (OR 2.09, $p < 0.001$). Amongst those with spine fractures, patients with the osteoporotic terrible triad were 33% more likely to have treatment recommended (OR 1.33, $p = 0.002$) and 23% more likely to have treatment initiated (OR 1.23, $p = 0.006$). Similarly, patients with Vitamin D deficiency were 29% more likely to have treatment recommended (OR 1.29, $p = 0.004$) and 90% more likely to have treatment initiated (OR 1.90, $p < 0.001$). Other factors that increased the likelihood of treatments recommended and initiated included those with a previous spine fracture (OR 1.61, $p < 0.001$ and OR 1.27, $p < 0.001$; respectively) and those on oral bisphosphonates (OR 1.55, $p < 0.001$; and OR 1.86, $p < 0.001$; respectively).

CONCLUSIONS: Vertebral bodies are a common site for both index and secondary osteoporotic fragility fractures. Multiple patient-related factors significantly increase the risk of fracture compared to other sites. Consistent with prior small retrospective studies, patients who have VCFs are more likely to have treatment recommended and initiated than other fragility fractures. Understanding the risk factors unique to vertebral fractures, as well as those associated with treatment recommendation and initiation serves as a critical component to understanding barriers to care, as well as improving management of the osteoporosis underlying fragility fractures.

PROMIS Physical Function and Pain Correlation with NDI and VAS in the Surgical Patient Population with Cervical Disc Herniations and Cervical Radiculopathy

Abstract ID: Poster 024

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BACKGROUND: Legacy patient reported outcome measures such as NDI (Neck Disability Index) and VAS (Visual Analog Score) are essential for analyzing treatments for cervical disc herniations with radiculopathy. Administrative burdens impose limits on completion of such measures. The Patient Reported Outcomes Measurement Information System (PROMIS) group developed a patient outcome measure to improve reporting of patient symptoms and function and to reduce administrative burden. Despite early success, NDI and VAS scores have not been compared with PROMIS in patients with cervical disc herniations with radiculopathy. The aim of this study is to compare correlations of NDI and VAS with PROMIS physical function and pain in a surgical patient population.

METHODS: 65 patients with cervical disc herniations with radiculopathy that went on to surgery were included. All patients were treated at the same university spine center by four surgeons. PROMIS, NDI, and VAS scores were collected preoperatively, at 1-4 months, and at 6 months. Correlations between NDI, VAS, and PROMIS were quantified using Pearson correlation coefficients. Student's t-tests were used to demonstrate correlation significance ($\alpha = 0.05$).

RESULTS: 65 (100%) of patients completed baseline preoperative questionnaires. 47 (72%) of patients completed all questionnaires at 1-4 month follow-up and 21 (32%) patients at 6 months. PROMIS physical function and NDI demonstrated a strong negative longitudinal correlation, with Pearson r values of (-0.82, -0.79, -0.82) at baseline, initial follow-up, and 6 months. PROMIS pain and VAS neck pain demonstrated an inconsistent positive correlation, with Pearson r values of (0.52, 0.59, 0.76) at baseline, initial follow-up, and 6 months. PROMIS pain and VAS arm pain demonstrated a weak positive correlation, with Pearson r values of (0.49, 0.57, 0.54) at baseline, initial follow-up, and 6 months. Student's t-test showed a P value of <0.0001 for all Pearson correlation calculations.

CONCLUSIONS: PROMIS physical function scores have a strong negative correlation with NDI scores at baseline and in the postoperative course in patients undergoing surgery for cervical disc herniations with radiculopathy. PROMIS pain scores have an inconsistent positive correlation VAS neck pain and a weak positive correlation with VAS arm pain scores at baseline and in the postoperative course. Surgeons may factor these outcomes into the delivery and interpretation of patient reported outcome measures in this patient population. Use of PROMIS may improve completion of outcome measures in the office and reduce administrative burden while providing reliable outcomes data.

PROMIS Physical Functioning Correlation with NDI and mJOA in the Surgical Cervical Myelopathy Patient Population

Abstract ID: Poster 025

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INTRODUCTION: Legacy patient reported outcome measures such as NDI (Neck Disability Index) and mJOA (modified Japanese Orthopedic Association score) are essential for analyzing treatment interventions for cervical myelopathy. Administrative burdens impose limits on completion of these measures. The Patient Reported Outcomes Measurement Information System (PROMIS) group developed an outcome measure with the goals of improving reporting of patient symptoms and function and reducing administrative burden. Despite early positive results of PROMIS, NDI, and mJOA scores have not been compared with PROMIS in patients with cervical myelopathy. The aim of this study is to compare NDI and mJOA with PROMIS to determine their correlations in a surgical patient population.

MATERIALS/METHODS: 60 patients with a diagnosis of cervical spondylotic myelopathy that went on to surgery were included in the study. All patients were treated at the same tertiary spine center by four different spine surgeons. Patients were seen and PROMIS, NDI, and mJOA measurements were collected preoperatively and during initial postoperative follow-up in the first 6 months. Correlations between NDI, mJOA, and PROMIS were quantified using Pearson correlation coefficient measurements. Student's t-tests were used to demonstrate correlation significance with alpha set at 0.05.

RESULTS: All 60 (100%) of patients completed baseline preoperative questionnaires. 55 (92%) of patients completed all questionnaires during initial follow-up in the first 6 months. PROMIS, mJOA, and NDI scores all improved significantly from preoperative assessment to initial follow up. PROMIS physical function and NDI demonstrated a strong negative correlation at baseline and in initial follow-up ($R = -0.69, -0.76$). PROMIS and mJOA demonstrated a strong positive correlation at baseline and in initial follow-up ($R = 0.61, 0.72$). Patients needed <1 minute and 4.11 questions on average to complete PROMIS. Students t-test demonstrated a P value of <0.0001 for all Pearson correlation calculations.

CONCLUSIONS: PROMIS physical function scores have a strong negative correlation with NDI scores both at baseline and early follow-up in patients undergoing surgery for cervical myelopathy. PROMIS physical function scores have a strong positive correlation with mJOA scores both at baseline and in the early postoperative course in patients undergoing surgery for cervical myelopathy. Surgeons may factor these outcomes into the interpretation of patient reported outcome measures in patients with cervical myelopathy undergoing surgery. Use of PROMIS assessments may improve completion of outcome measures in the office, reduce administrative burden while still providing reliable outcomes data.

What are the Costs of Cervical Radiculopathy in the Year Prior to Anterior Cervical Discectomy and Fusion?

Abstract ID: Poster 027

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INTRODUCTION: The majority of patients experiencing cervical radiculopathy (CRadic) have symptom resolution within 3 months, but for those failing non-operative (non-op) management, the gold standard treatment is Anterior Cervical Discectomy and Fusion (ACDF). While the costs of operative treatment have been previously described, less is known about the costs of CRadic leading up to ACDF. Thus, we sought to determine the costs associated with non-op management of CRadic in the year prior to ACDF.

METHODS: The Humana database was reviewed from 2007 to 2015 for all patients undergoing an ACDF for cervical radiculopathy. Only patients with claims records of at least 1 year prior to ACDF were considered. Myelopathy, trauma, and tumor patients were excluded. Costs for diagnostic tests (x-rays, CT, MRI) and non-op management (injections, physical therapy, braces, opioids, non-steroidal anti-inflammatories, and tramadol related to CRadic in the year prior to ACDF) were calculated. Cost was defined as reimbursement paid by the insurance provider. All costs, except hospital/facility fees, were analyzed relative to the overall costs for CRadic.

RESULTS: In total, 12,514 CRadic patients spent \$14,308,777 on non-operative diagnostic and treatment modalities during the year prior to ACDF (\$1,143 / patient). All of the patients underwent at least one diagnostic test, and 73.3% underwent non-op treatment. Diagnostic imaging comprised 47.7% of the total costs and standard non-operative treatments, 28.9%. MR imaging had the highest total relative spend of 28.4%, and the highest number of patients completing, 86.6% ($p < 0.05$). A relatively low number of people completed PT, 17.8%, with a relative total cost of 6.1%. Surgical treatment (ACDF), however, was dramatically higher per patient at an average of \$18,142 for the hospital stay, and \$4,457 in professional payments.

CONCLUSION: In the year prior to ACDF, nearly half of the non-inpatient costs associated with CRadic are from diagnostic modalities. A much smaller amount of the total spend was from non-operative treatments. With injections removed, only 12.8% of the non-operative spend was on treatments. As institutions begin entering into bundled payments for cervical spine disease, understanding condition specific costs is a critical first step.

What Are the Distractive Forces Applied During Percutaneous Reduction of a Single Level Lumbar Spine Burst Fracture?

Abstract ID: Poster 028

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INTRODUCTION: Minimally invasive spine surgery has become increasingly popular in recent years due to improved surgical techniques and impressive patient outcomes. The advent of novel surgical implants provides new opportunities and challenges. Among these challenges, the effect of distraction along the longer moment arms of percutaneous pedicle screw sleeves has not been described. Optimal configurations of prefixation screws, which allow the surgeon to lock the screw-tulip interface prior to reduction, has not been described. The purpose of this study was to investigate the effects of prefixation screw configuration on the distractive forces at a simulated lumbar burst fracture. We further sought to determine the impact of distraction forceps placement along the pedicle sleeve on the distractive forces at a simulated lumbar burst fracture.

METHODS: Twenty fresh porcine lumbar spines spanning T12-L4 were dissected to ligamentous structures. Specimens underwent osteotomy at the L2 vertebral body to produce a simulated burst fracture. The spines were inserted in a material testing system (MTS) machine. A pressure sensor was inserted into the L1-2 disc space. The MTS distracted the specimens with known forces to produce a scale comparing distractive force with measured intradisc pressure.

The specimens were randomized to one of four screw configurations. Two configurations utilized prefixation screws at the fracture site, and two configurations contained polyaxial screws at the fracture site. The specimens were instrumented with pedicle screws at the L1-3 levels using a percutaneous instrument set.

The spines underwent manual single segment distraction (L1-2) at three levels along the length of the pedicle sleeve to simulate greater soft tissue interposition. Changes in pressure in the L1-2 disc space were recorded.

RESULTS: Maximum distractive force was observed in the two configurations containing prefixation screws at the fracture site. These configurations were not significantly different from each other ($p = 0.288$), but allowed significantly more distractive force than configurations containing polyaxial screws at the fracture site ($p < 0.001$). The superiority of configurations with prefixation screws was maintained when the axis of distraction was moved dorsally along the pedicle screw sleeve. Distractive forces significantly decreased in all configurations as distraction was applied further dorsally along the pedicle sleeve ($p < 0.001$).

CONCLUSION: Prefixation screws allowed significantly increased distractive force to the fracture site in a lumbar burst fracture model. Distractive force at the fracture site significantly decreased as the forceps were applied further away from the construct, highlighting a limitation of percutaneous surgery.

TRAUMA

Efficacy and Safety of Percutaneous Reduction and Sacroiliac Screw Placement: A Review of Pediatric Patients at a Single Institution

Abstract ID: Poster 029

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PURPOSE: Current literature regarding unstable pelvic ring injuries in the pediatric population supports that treatment of instability and displacement should be treated surgically, rather than conservatively, due to insufficient remodeling potential from these injuries. Percutaneous reduction and fixation has been well described in the adult literature, but there is a paucity of information in the skeletally immature population. Our aim is to review these cases at a single institution and report complications, operative data, and quality of reduction with a pelvic reduction frame.

METHODS: An IRB approved retrospective review was performed of 26 consecutive skeletally immature patients with posterior pelvic ring injuries that underwent percutaneous intervention by a single surgeon from 2007-2016. Inclusion criteria include a Risser value of 4 or less along with an unstable posterior pelvic ring injury that required sacroiliac (SI) fixation. Data parameters reviewed include age, operative data, quality of reduction, post-surgical complications, and classification of fracture type using the Young-Burgess system.

RESULTS: Twenty-six patients (15 male, 11 female) with average age of 10.3 years (1-17 range) and unstable pelvic ring injuries were treated with percutaneous posterior pelvic ring reduction and fixation. Average follow-up was 15 months (1-46 range). In our cohort, all patients exhibited an immature Risser sign (0-4) and 14 had open tri-radiate cartilage. The distributions of fracture patterns was 16 lateral compression, 4 vertical shear, 5 AP compression, and 1 combined mechanism. At the time of injury, average maximal displacement was 11.4 mm. After reduction and fixation, all but 3 patients showed less than 4 mm of residual displacement. When patients who had concomitant interventions in the same setting were excluded the average estimated blood loss was 20 ml. The mean anesthetic time was 142 minutes and average length of stay was 14 days. The average return to full weight bearing was 9 weeks. There were no iatrogenic nerve injuries. There were two superficial external fixator pin site infections. There were 12 elective hardware removals.

CONCLUSION: Percutaneous fixation of the posterior pelvic ring is a viable treatment option in the skeletally immature population and allows for restoration of pelvic ring alignment with minimal blood loss, minor complications, and quick return to activity.

The Terminal Position of a Tibial Intramedullary Nail Should Be Eccentric: A Computed Tomography (CT) Based Study

Abstract ID: Poster 030

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INTRODUCTION: Distal tibia fractures treated with intramedullary nails are prone to malalignment due to the absence of interference fit in the diaphyseal-metaphyseal region. Traditional teaching dictates that the intramedullary nail should be targeted for the anatomic center-center of the distal tibia. Considering how the tibia asymmetrically widens distally, we hypothesized that the terminal position of an intramedullary nail is eccentric. The purpose of this study was to define where a nail should terminate in the distal tibia to enable anatomic reduction of distal tibia fractures.

MATERIALS AND METHODS: This study was a prospective evaluation of CT images obtained from 6 intact cadaveric legs and 8 patients with midshaft tibial fractures. Midshaft tibia fractures were selected as the clinical correlate of cadaveric tibias because the narrow mid-diaphyseal medullary canal allows an anatomic nail trajectory into the distal tibia with minimal affect from the fracture. All nails were 10 or 11 mm, placed with an ideal starting point, and terminated just proximal to the distal physeal scar. Both patients and cadavers had a CT scan. Patients also had fluoroscopic images of the ankle. On axial CT and fluoroscopic mortise views, the nail end-point was recorded as a ratio of tibial width, and on axial CT the distance from distal tibia center to nail center was calculated (figure attached). All measurements were performed using ImageJ (National Institute of Health, Bethesda, Maryland). Statistical analyses were performed using two tailed t-tests assuming unequal variances against the assumption that the nail terminates in the center of the distal tibia.

RESULTS: On axial CT, the average distance from the medial tibial cortex to the nail center as a ratio of medial-lateral tibial width was 0.63, $p < 0.01$ (Cadaver = 0.68, $p < 0.01$) (Patient = 0.60, $p < 0.01$). On axial CT, the average distance from the center of the distal tibia to the center of the nail was 4.43 mm, $p < 0.01$ (Cadaver = 5.53 mm, $p < 0.01$) (Patient = 3.75 mm, $p < 0.01$). On patient fluoroscopic mortise views, the distance from the medial cortex to the nail center as ratio of medial-lateral tibial width was 0.61, $p < 0.01$.

CONCLUSIONS: The distal end-point of a tibial intramedullary nail is lateral to the anatomic center in both cadaveric tibias and patients with midshaft tibia fractures. These results suggest that the treatment of distal tibia fractures with intramedullary nails may be improved by positioning the nail slightly lateral in the distal fragment, reducing the risk of malalignment.

Comparing Outcomes in Tension Band Fixation of Patellar Fractures with K-Wires vs. Cannulated Screws

Abstract ID: Poster 031

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INTRODUCTION: The modified tension band technique has long been the standard of care for displaced patellar fractures. However, K wire fixation of tension band constructs is frequently associated with painful hardware and skin irritation. Cannulated screw fixation has been proposed as a method to improve knee stabilization and rates of symptomatic hardware. The purpose of this study was to assess if tension band fixation with cannulated screws decreases complication rates and improves secondary outcomes.

METHODS: This was a retrospective cohort study of 85 patients with surgically repaired patellar fractures who presented between 2008-2014. Patients who were treated by tension band fixation with K wires or cannulated screws and had follow-up greater than 12 weeks were included. Multivariate logistic regression was performed on age, gender, fixation, fracture type, associated injuries, and case length to evaluate their effect on complication rate. Secondary outcomes including pain, ROM, and time to union were analyzed using Chi-squared and Mann-Whitney.

RESULTS: Of the 85 total patients, 17 underwent tension band fixation with cannulated screws and 68 were treated by tension band fixation with K wires. There were no significant differences between the two groups in demographics, associated injuries, fracture type, time between fracture and surgery, or case length. Multivariate logistic regression showed that the complication rate was independently influenced by type of fixation (p-value 0.016) with an odds ratio of 0.057 in the cannulated fixation group. Age, gender, associated injuries, and fracture type were not associated with increased rates of complication. The majority of complications were due to symptomatic hardware in 29.41% of K wire cases vs. 0.00% of cannulated cases (p-value 0.009). Of the K-wire group, 1.18% had infected hardware (p-value 1.0) and 7.06% had hardware failure (p-value 0.342) compared to no such cases in the cannulated screw group. Overall, complications led to reoperation in 35.29% of K wire cases and 5.88% of cannulated cases (p-value 0.017). Mann-Whitney U Test showed no difference in time to union or ROM during the 0-3 month, 3-6 month, and 6-12 month time periods. There was a moderate association with K-wire fixation and increased pain (p-value 0.044). Median time to follow-up was 29 weeks.

CONCLUSION: In this retrospective study, tension band fixation with cannulated screws was found to be an independent predictor of decreased complication and reoperation rates. However, follow-up measures including time to union and ROM do not exhibit an overtly similar benefit.

What is the Ideal Starting Point for an Olecranon Screw? An Anatomic Cadaveric Study

Abstract ID: Poster 032

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PURPOSE: Recent work has shown that intramedullary screw fixation of the proximal ulna can provide a rigid and low profile form of fixation with low rates of re-operation. However, an incorrect starting point can cause malreduction, inadequate fixation, and possibly poor functional outcomes as with any intramedullary nail. Our hypothesis was that the "center-center" position would be the ideal starting point that leads to minimum fracture displacement when placing an intramedullary screw in the ulna.

METHOD: Thirty-six shoulder disarticulated arms (18 pairs, average age: 82, range: 71-104) had a standard posterior surgical approach to the olecranon. Each arm was randomized into one of the three different starting points: Center-Center, Posterior-Lateral, Posterior-Medial. Our primary outcome measure was the amount of displacement in millimeters at the fracture site on the articular and cortical surfaces. Measurements were compared across each combination of starting-point locations using the Kruskal-Wallis rank sums test. The sign test was used to determine if the median measurement from each location differed from anatomic reduction.

RESULTS: The articular step-off measurements were significantly different between center-center (0.6 mm) vs. posterior-medial (2.1 mm) groups ($p=0.01$) and approached significance with posterior-medial compared to posterior-lateral (0.9 mm) locations ($p=0.07$). No significant difference was found with comparison of center-center to posterior-lateral locations ($p=0.7$). Additionally, the medial based starting point demonstrated significant cortical step-off (1-1.75 mm; $p<0.04$) in comparison to both center-center and posterior-lateral positions in posterior, medial, and lateral cortical surfaces.

CONCLUSION: Malreduction of a simulated, simple olecranon fracture as measured by articular step-off was most significant when the starting point for the intramedullary screw was malpositioned medially. A central- or laterally-based starting point was more forgiving, likely due to the varus bow of the proximal ulna accommodating a slightly lateral starting point. Avoiding a medially-based starting point is crucial for surgeons attempting to utilize the reported benefits of this technique and reduce the chance of malreduction after implant placement.

Complications After Pelvic Arteriography in Patients with Pelvic Ring Disruptions

Abstract ID: Poster 033

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INTRODUCTION: Pelvic fractures in trauma patients are associated with significant morbidity and mortality, further amplified in the setting of hemorrhagic shock. Pelvic angiography with transcatheter arterial embolization (TAE) is an established intervention for treatment of pelvic arterial hemorrhage. Pelvic angiography with or without TAE was instituted at our institution in 2003 as part of a multidisciplinary institutional pelvic fracture protocol. The purpose of this study was to analyze complication rates after angiography among pelvic trauma patients treated in the context of this protocol.

METHODS: Prospective data was collected from our Level-1 National Trauma Registry of The American College of Surgeons database. A retrospective database analysis and chart review was then conducted. Demographics and fracture type were noted. Embolizations were classified as unilateral or bilateral and selective or nonselective. Possible complications of pseudoaneurysm, renal failure, pelvic soft tissue necrosis or infection, and anaphylactic reactions to the intravenous contrast were noted.

RESULTS: 710 patients with pelvic and/or acetabular fractures were screened. Complete data was available on 81 patients with pelvic ring injuries who underwent angiography between 2009 - 2013. Complications among 41 patients who underwent transcatheter arterial embolization (TAE) were compared with a control group of 40 patients. 8/41 patients with TAE had complications (19.5%) compared with complications in 3/40 (7.5%) patients who underwent angiography without TAE ($P=0.19$). Overall complication rate was 13.6%. Average Injury Severity Score (ISS) was 33.8 and 28.3 ($P=0.09$), respectively.

DISCUSSION AND CONCLUSION: It is difficult to attribute a complication solely to TAE. Complications are likely a result of the traumatic injury with TAE possibly acting as a "second hit." In the setting of severely injured trauma patients who meet criteria for pelvic angiography, use of this modality as part of an institutional pelvic fracture protocol carries with it an acceptable rate of complications.

Is the American Orthopaedic Association Own the Bone Database a Representative Sample of Patients Presenting with Osteoporotic Fragility Fractures – A Comparative Analysis

Abstract ID: Poster 034

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INTRODUCTION: The American Orthopaedic Association initiated the Own the Bone quality improvement program in 2009 as a means for improving the clinical understanding and management of osteoporosis. In this study, we present a summary of the data collected by the Own the Bone program; we aim to validate this registry by comparing and contrasting it to other large sample cohort studies that have been historically used to characterize osteoporosis in the United States.

METHODS: This study analyzed the data in the Own the Bone (OTB) program registry, which contains 35,039 unique cases of fragility fracture occurring in patients presenting to one of 179 sites nationwide. Upon enrollment, a standardized case report form was completed for all patients and the collected data was transcribed into a master database securely maintained by the OTB program. We report the demographics, presenting fracture characteristics, past fracture history, and DEXA scan data for all enrolled patients and compare these to data obtained from large epidemiological surveys and pivotal anti-osteoporosis medication trials.

RESULTS: Seventy-three percent of the patients characterized the prototypical patient at risk for osteoporosis--female, Caucasian, and post-menopausal. In 54.4% of cases, patients presented with a hip fracture while spine fractures were the second most common presenting fracture type occurring in 11.1% of patients. Thirty-four percent of patients had a past history of any fragility fracture, and the most common site was the spine. The average femoral neck T score was -2.05 (range, -5 to 3.5). When compared to the NHANES database and the largest anti-osteoporosis medication RCTs, the OTB database showed similar findings with regards to patient age, race, bone mineral density (BMD) profile, and BMI profile as well as prior fracture history, and family history of osteoporotic fractures.

CONCLUSION: Statistical analysis of the data collected through the Own the Bone program demonstrates that it is similar to that collected in other large studies. As such, the Own the Bone registry functions as an externally valid, rich, and useful cohort for studying patients with osteoporosis. OTB is the first and largest multi-center, prospective study to specifically analyze the clinical characteristics of patients presenting with fragility fractures.

Hoffa Fracture Fixation: Comparison of Lag Screws and Lag Screws Plus Anti-Glide Plate Fixation

Abstract ID: Poster 035

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PURPOSE: Isolated distal femoral condyle fractures in the coronal plane are a rare and minimally studied fracture pattern. There have been very few biomechanical studies comparing the stability of fixation of isolated Hoffa fragments. This study investigates the difference in stiffness of compression screws versus compression screw plus buttress plate fixation of isolated Hoffa fragments.

METHODS: We utilized 20 fourth generation composite femur sawbones to simulate young healthy bone. A standardized condylar fracture was produced using an osteotomy template cutting jig to create an isolated Hoffa fracture simulating proximal apex comminution of the lateral condyle in each distal femur. Specimens were divided into two groups, one group fixed with two anterior to posterior compression screws (CS) and one group fixed with screws and posterior anti-glide plate (AGP).

Stabilized specimens were then mounted in an MTS machine and a loading force simulating single stance weight bearing was applied to the specimens. The load was applied parallel to the fracture line to simulate maximal shear stresses until failure. The stiffness of each specimen was calculated in newton millimeters from the slope of the force-displacement graph and then averaged for each group. The force required for each fracture to displace greater than 2 mm was measured for each specimen.

RESULTS: There was no significant difference ($p=0.12$) in stiffness between the compression screw (CS) group (120.06 ± 9.20 N/mm) and the compression screw anti-glide plate group (AGP) (129.86 ± 16.84 N/mm). The average R-value for the slope of each curve was 0.95 ± 0.025 in the CS group and 0.97 ± 0.023 in the AGP. There was also no significant difference ($p=0.28$) in the load to failure in the CS group (426.69 ± 57.02 N) and the AGP group, (400.57 ± 49.49 N). Post-hoc power analysis of the stiffness of each group with an alpha of 0.05 was calculated to be 0.34.

CONCLUSION: The stability of an isolated Hoffa fracture with proximal comminution fixation in young healthy bone was not increased with the addition of a posterior anti-glide plate, and can possibly be treated with compression screws alone. This has implications in terms of the surgical exposure required to place a posterior anti-glide plate especially if this appears to be an unnecessary fracture fixation adjuvant. Further studies however are needed to examine fixation stability in osteoporotic bone.

Alcoholics That Experience Delirium Tremens During Admission for Hip Fractures Experience Higher Morbidity

Abstract ID: Poster 036

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INTRODUCTION: Poor outcomes are often reported with alcohol abuse as a confounding comorbidity in patients suffering hip fractures. When delirium tremens does occur in an alcoholic patient suffering a hip fracture, there is increased morbidity. Thus far, no studies have reported the concurrent effects of DT in alcoholic patients with hip fractures.

METHODS: A retrospective chart review of 340 patients was conducted of patients with hip fractures, with and without alcohol abuse, and with and without DT diagnosed during hospitalization at a state tertiary referral and Level 1 trauma center over a 10-year period. We evaluated the occurrence of DT in alcoholic hip fracture patients and documented inpatient hospital morbidity events, mortality, length of stay (LOS), and usage of critical care services compared to alcoholic patients without DT abusing non-DT suffering patients.

RESULTS: Patients without a history of alcohol abuse were older than patients with alcohol abuse or DT ($p < 0.01$). Non-abusing patients were more likely to be female than the non-DT abusing patients or the DT group ($p < 0.01$). Non-alcohol abuse patients had more comorbidities than non-DT alcohol abuse and DT patients ($p < 0.01$). Patients with DT had longer LOS (mean of 19.57 days) than non-alcohol abuse patients (6.98) and alcohol abuse patients without DT (6.25) ($p < 0.01$). Differences in ICU admissions were seen between the groups, with (11.9%) non-alcohol abusing patients admitted, (10.5%) of non-DT alcohol abuse patients admitted, and (71.4%) of DT patients submitted ($p < 0.01$).

CONCLUSION: In alcoholic patients sustaining hip fractures complicated by delirium tremens, significant increases in length of stay (both overall and in ICU), they were more likely to require ICU stay and suffered higher rate of inpatient complications. Increased likelihood of entering the ICU and increased inpatient complication rates occurred. Based on these findings, we recommend the routine use of DT prophylaxis in at-risk patients to prevent these significant increases in morbidity and resource utilization.

Intraoperative Computed Tomography of the Syndesmosis: Incisura Morphology Affects Malreduction and Radiation Exposure

Abstract ID: Poster 037

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BACKGROUND: Syndesmosis malreductions remain the primary cause of unintended reoperation in the foot and ankle. Many studies and techniques have attempted to understand risk factors or techniques to help improve malreduction rates, but little consensus has been obtained. The purpose of this study was to look at morphologic influences on malreduction rates using radiographic measurements obtained from intraoperative computed tomography (CT) during syndesmosis surgery.

METHODS: A retrospective chart review was conducted on 37 consecutive patients who received intraoperative CT imaging as part of their operation. Syndesmosis and incisura geometrical morphology measurements were recorded on the contralateral ankle. The group of patients who were correctly reduced on the index CT scan were compared to patients who were malreduced after the first scan. Cumulative radiation exposure was measured as a secondary outcome.

RESULTS: All 37 patients were able to have anatomically reduced syndesmoses, but only 24 patients (65%) were reduced after the first scan. There was a significant difference in the ratio between tibial incisura length to depth between the initially reduced and malreduced groups (6.25 vs. 7.71, respectively. $p = 0.03$). The radiation exposure for the initially malreduced patients was significantly higher than patients initially anatomically reduced (421 mGycm vs. 143 mGycm, $p < 0.001$).

CONCLUSIONS: Previously published studies used absolute values of incisura depth to predict malreduction rates of the syndesmosis. These findings suggest that a relative ratio between the incisura depth and width is more predictive of syndesmosis malreduction, rather than absolute values. Due to the vast variations in normal syndesmosis anatomy, contralateral ankle CT imaging may provide more useful surgical information than the affected limb alone.

Rate of Symptomatic Hardware Removal Related to Body Mass Index

Abstract ID: Poster 038

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BACKGROUND: After surgically treating ankle fractures, orthopedic surgeons continue to have difficulty predicting which patients will develop symptoms related to their internal fixation. Several studies have attempted to identify which variables, if any, may help predict symptomatology and subsequent removal of hardware (ROH). Sex, age, and length of operation have all been proposed as possible risk factors for eventual symptomatic hardware. In addition to these factors, we also wanted to study the effect of BMI on symptomatic hardware requiring ROH – with the idea that higher BMI patients have a thicker soft tissue envelope over the hardware and thus experience less soft tissue irritation compared to their lower BMI counterparts.

METHODS: We performed a retrospective cohort analysis of all patients with an ankle fracture undergoing surgical fixation at a university affiliated tertiary medical center in Southeast Michigan from July 2013 to January 2016. We included patients who underwent open reduction and internal fixation of any kind for rotational ankle fractures and those who underwent ROH for pain or discomfort. We excluded patients undergoing ROH for infection or hardware failure. We collected demographic data as well as individual comorbidities and smoking status.

RESULTS: 876 patients were included in the study. Twenty-nine patients were excluded from our study because their ROH was secondary to infection or hardware failure. There were 362 males and 489 females included in the study. The average age of our patients in the ROH group was 45.1 versus 48.2 who had retained hardware ($p = 0.06$). The ROH group had a lower rate of hypertension (29.1% versus 41.6%, $p = 0.03$), otherwise there were no significant differences among the groups in terms of medical co-morbidities or smoking history. All patients had a minimum of 275 day follow-up, with the average follow-up being 12 months. We used hazard ratios to determine if there was an association between any of the variables we collected. We found that syndesmotic screw fixation was associated with an increased risk of requiring ROH (OR 1.85, $p = 0.01$). There was no significant difference between the BMI in patients who required ROH versus those who retained their internal fixation hardware.

CONCLUSION: This study showed that younger age and hypertension are independent risk factors for symptomatic hardware and subsequent ROH while BMI, other medical comorbidities and smoking status were not risk factors. Further studies are needed to elucidate a patient's risk factors for experiencing symptomatic hardware.

Investigation of Bone Quality of the First and Second Sacral Segments of Normal and Dysmorphic Sacra

Abstract ID: Poster 039

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INTRODUCTION: Optimal and safe placement of sacral fixation using cannulated screws has been well described, including recent studies that have evaluated sacral screw placement in dysmorphic sacra and anatomical variants. Although safe zones have been described, there's little mention of the quality of the surrounding bone density for fixation. The purpose of this study is to determine if there is radiographic evidence of a difference in bone density at S1 compared to S2 in normal and dysmorphic sacra.

METHODS: The pelvic computed tomography (CT) scans of 50 consecutive trauma patients without pelvic injuries between the ages of 18 and 50 were prospectively evaluated. Dysmorphic sacra were identified on the basis of: (1) upper sacral segment not recessed in the pelvis, (2) presence of mammillary bodies, (3) acute alar slope, (4) residual disc between the first and second sacral segments, or (5) noncircular upper sacral neural foramina by two independent musculoskeletal radiologists. Hounsfield unit (HU) density values were determined on both the S1 and S2 segments of each CT scan. The mean HU at S1 and S2 between normal and dysmorphic sacra were then compared.

RESULTS: Of the 50 CT scans reviewed, the most common dysmorphic feature was residual disk (64%), followed by mammillary bodies (18%), acute alar slope (12%), misshapen sacral foramen (12%), and the upper sacra not recessed in the pelvis (10%). A statically significant difference in bone quality was found when comparing the first and second sacral segment ($p = 0.0027$). Normal and dysmorphic sacra had no differences in bone quality at the S1 segment. In sacra with >3 dysmorphic features, the S2 segment had a significantly lower bone quality than those with ≤ 3 dysmorphic features ($p = 0.028$). Age, gender or smoking status did not affect bone quality.

DISCUSSION AND CONCLUSION: There is a statistically significant difference in the bone density of the first sacral segment compared to the second sacral segment in normal and dysmorphic sacra. The second sacral segment had significantly less bone quality in sacra with greater than 3 dysmorphic features compared with sacra demonstrating less than 3 dysmorphic features. This study highlights the need for future biomechanical studies to investigate if this difference is clinically relevant due to the relative osteopenia in the second sacral segment and guide further strategies for fixing dysmorphic sacra.

Floating Ankle Injuries: Consecutive, Multicenter Series of Patients with Ipsilateral Distal Tibia and Calcaneus Fractures

Abstract ID: Poster 040

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INTRODUCTION: In isolation high energy fractures of the distal tibia and calcaneus have unique treatment challenges. There are limited reports in the literature describing outcomes of combined distal tibia and calcaneus fractures, or the “floating ankle injury”. The purpose of this study is to highlight the characteristics of the injury, number and type of early and late operations, complications, and mid-term clinical outcomes.

METHODS: Patients at two Level 1 trauma centers that underwent operative fixation of distal tibia and calcaneus fractures in the same extremity from January 2001 to January 2015 were identified. 23 patients underwent fixation of acute distal tibia and calcaneus fractures to the ipsilateral extremity during the study period. 4 patients had bilateral distal tibia and calcaneus fractures for a total of 27 injured limbs. Patients were contacted by mail and phone to collect Foot and Ankle Ability Measure (FAAM) and Short Form-36 (SF-36) scores.

The average age was 40.4 years (Range 20-79) at the time of injury. Only 6 patients were female (26%). The most common mechanism of injury was enclosed motor vehicle accident (14/23 patients). 56% of limbs had open fractures (15/27). Average follow-up was 25 months (Range 1-120 months). 4 patients (2 with bilateral injuries) were excluded from the final analysis because of follow-up less than 3 months despite attempts to contact the patient.

RESULTS: Patients underwent an average of 2.6 acute operations for fixation of these injuries (Range 1-7 operations). 2 patients required free flap soft tissue coverage (GA Type IIIB). Open reduction internal fixation (ORIF) was used for definitive fixation of the tibia fracture in 70% (19/27) of cases. Definitive external fixation was used all other tibia fractures. Percutaneous reduction and fixation was used fixation in 85% (23/27) of calcaneus fractures.

Of patients with at least 3 months follow-up, 14% (3/21) of limbs underwent late amputation. 6 limbs underwent acute (1) or subsequent subtalar fusion (5/21, 24%). Two of these patients also had a late ankle fusion at the time of subtalar fusion. Overall, 43% (9/21) limbs underwent late operations for complications of the trauma. 3 patients had deep surgical site infection requiring operative intervention.

DISCUSSION AND CONCLUSIONS: Ipsilateral distal tibia and calcaneus fractures are uncommon. The injury is often open (56%), occurs with a high-energy mechanism, has a high incidence of post-traumatic osteoarthritis requiring delayed fusion (24%), not uncommonly results in late amputation (14%), and has low patient reported outcome scores.

GENERAL

Increasing Perioperative Communication with Automated Mobile Phone Messaging in Total Joint Arthroplasty

Abstract ID: Poster 041

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BACKGROUND: The use of software-driven automated mobile phone messaging (messaging robots) in health care is increasingly utilized. Automated mobile phone messaging has not previously been trialed in patients undergoing total joint arthroplasty (TJA). The purpose of this pilot investigation was to evaluate the utility of automated mobile phone messaging in TJA by (1) comparing Press Ganey (PG) and Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores between TJA patients who did and did not receive automated mobile phone messages and (2) evaluating patient satisfaction with automated mobile phone messaging communication in post-participation surveys.

METHODS: Patients received daily messages for 1 week prior and 2 weeks after TJA. All messages were sent by a software program with no human intervention required. The content of messages included reminders for date of surgery, medication details, activity, and pain control. On completion, patients answered a questionnaire which included select PG/HCAHPS questions and questions regarding their experience with the automated software messaging platform. Average PG/HCAHPS question scores in the pilot cohort were compared to historical TJA patients in the three-year window prior to this investigation (control group) using standard statistical techniques with significance defined as $P < 0.05$.

RESULTS: Thirty-seven consecutive patients were approached for this investigation and 92% ($n=34$) were enrolled. The experimental group consisted of 18 females (52%) and 16 males (47%), with 80% patients between 51-75 years. Of the 34 patients enrolled, 30 completed the study; 4 patients either provided wrong information or surgery was delayed outside the study period. The experimental ($n=30$) and control groups ($n=23$) were similar in regards to education and race. Patients receiving automated mobile phone messages were more likely to have a good understanding of health responsibilities ($p=0.024$), and feel the care team practiced shared decision making ($p=0.024$) compared to the control group. Of patients enrolled, 87% felt messages helped them be more prepared for surgery, 100% felt messages kept them better informed during recovery, and 97% would participate in automated mobile messaging system again.

CONCLUSION: Patients who received automated mobile phone messages had improved patient satisfaction scores postoperatively. Additionally, patients felt this form of communication was useful and kept them better informed after surgery. Tools such as this may be helpful to

surgeons and case managers as they continue to increase communication efforts with joint replacement patients to provide cost effective, quality care.

Delayed Vancomycin Infusion with Dual-Agent Antibiotic Prophylaxis Increases Prosthetic Joint Infection Risk Following Lower Extremity Joint Arthroplasty Surgery

Abstract ID: Poster 042

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INTRODUCTION: Dual-agent antibiotic prophylaxis has been shown to decrease total knee arthroplasty (TKA) prosthetic joint infection (PJI) rates. At our institution, dual-agent prophylaxis with a first-generation cephalosporin and a single perioperative vancomycin dose has been associated with decreased hip and knee arthroplasty PJI, including lower MRSA and polymicrobial infection rates. This conflicts with studies associating vancomycin and adherence to Surgical Care Improvement Program (SCIP) guidelines with increased PJI risk. However, no relationship between antibiotic timing and PJI has been established. We performed this study to determine whether vancomycin administration timing may influence prosthetic joint infection risk.

METHODS: After obtaining IRB approval, we identified 19 PJI patients from a cohort of 1,169 primary or revision hip and knee arthroplasties (1.6%) performed with a first generation cephalosporin and a single vancomycin dose between January 2012-April 2015, accommodating a minimum 2-year follow-up. The cohort included 610 primary TKA, 350 primary THA, 112 Revision TKA, and 97 Revision THA procedures. Demographic features of PJI and non-infected patients were compared. Timing of antibiotic administration for PJI patients was also assessed. Statistical analysis was accomplished using a paired student's t-test or Fisher's Exact Test, with a p-value < 0.05 accepted as significant.

RESULTS: PJI and non-infected cohorts were not different in age (58.4 vs. 59.9 years, $p=0.93$), BMI (34.2 vs. 35.0 kg/m², $p=0.67$), ASA Class (2.73 vs 2.54, $p=0.13$), or female gender (63.1% vs 55.9%, $p=0.64$). Infection rates were significantly lower for primary TKA (1.7%), primary THA (1.6%), and revision THA (0%) compared with revision TKA (4.8%) ($p=0.02$). Patients developing PJI were more likely to have a negative culture or infection associated with coagulase negative staphylococcus, MRSA, or enterococcus than MSSA infection (63% vs. 16%, $p<0.01$). Seventeen patients (89%) who developed a PJI had vancomycin administration initiated no earlier than 40 minutes ahead of their surgical incision (mean time 23.7 +/- 12.1 minutes, range 0-40 minutes).

CONCLUSION: Dual agent prophylaxis with a first generation cephalosporin and vancomycin can effectively decrease hip and knee PJI infection rates. However, nearly all PJI infections identified at our institution when this approach was used occurred when vancomycin was not completely infused prior to the surgical incision. The study findings supports ensuring adequate pre-incision vancomycin infusion to help reduce PJI risk.

Surgical Treatment of Vertical Femoral Neck Fractures: Finite Element Analysis of Modern Day Fixation Constructs

Abstract ID: Poster 043

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OBJECTIVES: The aim of this study is to use a finite element analysis to compare four commonly used fixation constructs to treat vertical femoral neck fractures and determine which technique provides optimal stability.

METHODS: From computed tomographic data of a fresh-frozen thigh, a three-dimensional geometric model of the proximal femur was generated through volumetric reconstruction. Five fixation configurations of an anatomically reduced vertical femoral neck fracture were then constructed with placement of either three partially threaded 6.5 mm cannulated screws, a dynamic hip screw (DHS), a DHS with a 6.5 mm partially-threaded anti-rotation cannulated screw, or a DHS with a 2.7 mm medial buttress plate fixed either distal to the fracture, or both proximal and distal to the fracture. Physiologic loads approximating those during normal walking and ascending stairs were applied to evaluate stress in the construct and motion at the fracture site.

RESULTS: Among the five fixation constructs, DHS with a 6.5 mm partially-threaded anti-rotation screw has the lowest fracture micromotion (0.15 mm) and von Mises stress (33.8 MPa).

CONCLUSION: This study demonstrates that fixation of a vertical femoral neck fracture with a DHS and supplemental cannulated screw minimizes fracture micro-motion and stress in the construct compared to four other commonly used fixation strategies. While clinical comparisons of modern day fixation constructs to treat this challenging fracture have not yet been investigated, our FE analysis suggests that optimal treatment may be achieved with the aforementioned construct.

Dual-Agent Antibiotic Prophylaxis Using Single Dose Vancomycin Effectively Reduces Prosthetic Joint Infection Rates with Minimal Renal Toxicity Risk

Abstract ID: Poster 044

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INTRODUCTION: First generation cephalosporins provide effective prophylaxis against most skin flora but may not adequately cover low virulence organisms, including coagulase negative staphylococcus. We performed this study to assess the relative effectiveness of PJI prophylaxis using a first generation cephalosporin (Ancef) alone, ancef + vancomycin (A-V), or ancef + gentamicin (A-G), and the associated risks of renal impairment.

METHODS: After obtaining IRB approval, we retrospectively reviewed 3,337 consecutive primary and revision lower extremity total joint arthroplasties, including 1,428 patients receiving Ancef alone (A), 1,178 patients receiving cefazolin and a single dose of vancomycin (A-V), and 731 patients receiving cefazolin and a single dose of gentamicin (A-G). A chart review was performed to determine patient demographic characteristics, physiological response to surgery, and incidence of subsequent septic or aseptic surgical procedures. Statistical assessment was accomplished using a paired student's t-test or Fisher's Exact Test, with a p-value < 0.05 accepted as significant.

RESULTS: Dual-agent A-V prophylaxis had substantially lower infection rates during the first 2 years after primary TJA compared with patients receiving either A or A-G prophylaxis (1.6% vs. 2.9%, p=0.04) and after revision THA also (1.1% vs 12.5%, p=0.04). Patients who received Ancef alone and sustained a periprosthetic infection were more likely to have polymicrobial infections (25% vs. 10%, p=0.05) or MRSA infection (13.8% vs. 2.8%, p=0.04) than patients who received either dual-antibiotic PJI prophylaxis. There was a trend towards a proportion of patients with uncorrected creatinine elevation > 1.5 mg/dl (0.4% vs. 0.07%, p=0.06), but no patients in the A-V group required hemodialysis.

CONCLUSION: While first generation cephalosporins lower PJI infection rates, infections with low virulence organisms may still occur. In our institution, the addition of a single dose of Vancomycin effectively reduced PJI infection rates in primary TJA and revision THA with a low risk of renal impairment.

Patients who received Ancef alone and sustained a periprosthetic infection were more likely to have polymicrobial infections (25% vs. 10%, p=0.05) or MRSA infection (13.8% vs. 2.8%, p=0.04) than patients who received either dual-antibiotic PJI prophylaxis.

Patients receiving the A-V prophylaxis were slightly younger (mean age 59.8 vs. 61.8 years, p<0.001) with a higher mean BMI (BMI 34.9 vs. 33.9 kg/m², p<0.001), and a slightly greater medical complexity (Mean ASA 2.55 vs 2.42, p<0.001). There were no statistically significant differences between PJI prophylaxis groups with respect to mean hemoglobin or creatinine levels and similar proportions of patients had an elevation of creatinine level > 1.2 mg/dl

following surgery (10.2% vs. 9.2%, $p=0.36$). There was a trend towards a proportion of patients with uncorrected creatinine elevation > 1.5 mg/dl (0.4% vs. 0.07%, $p=0.06$), but no patients in the A-V group required hemodialysis.

CONCLUSION: Prosthetic Joint Infection carries high personal, social, and economic costs. A variety of approaches can be considered to reduce infection risk. While first generation cephalosporins lower PJI infection rates, infections with low virulence organisms may still occur. In our institution, patients who received a first generation cephalosporin alone were more likely to develop a polymicrobial infection or infection with MRSA compared with patients receiving a second agent. Infection rates were significantly lower for patients who had received dual-agent PJI prophylaxis with vancomycin than gentamicin. Rates of renal impairment were low, and long-term elevation of creatinine levels above 1.5 were less frequent than identified rates of PJI.

The Accuracy of Orthopedic Residents and Surgeons When Drilling at Various Angles

Abstract ID: Poster 045

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INTRODUCTION: Surgeons commonly use freehand techniques to estimate angles based on anatomical landmarks. However, inter-patient variations, patient positioning, and possible differences in technical skill, make the freehand approach unreliable. While there have been tremendous efforts to improve surgical techniques, there does not appear to be a cost effective, validated technology that accurately measures drill angles. The purpose of this study is to evaluate the accuracy of orthopedic residents and surgeons when drilling at various angles with and without the aid of an inexpensive digital guide.

METHODS: Orthopedic residents and surgeons were instructed to drill pins at 15, 30, and 45 degrees into PVC tubing. The pins were drilled in relation to a reference pin that was placed at random angles from the horizontal axis. They performed this exercise twice: first by freehand and a second time with a digital guide. The digital guide attaches to a drill and displays real time angle measurements. Results were recorded and analyzed.

RESULTS: A total of 11 participants: 8 orthopedic residents and 3 orthopedic surgeons were recruited for this study. Freehand drilling appeared to be less accurate across all angles drilled with a mean error of 6.28 degrees (standard deviation of 4.55 degrees), while the mean error using a digital guide was 1.82 degrees (standard deviation of 1.56 degrees). The mean error was defined as the average difference between the desired angle and the actual angle drilled. At 45 degrees, the mean error reached 9.01 degrees when drilling freehand, whereas the mean error using the digital guide remained under 2.1 degrees. The mean error for freehand drilling was significantly greater than using a digital guide (p value = 0.001) when performing a paired T-Test analysis.

CONCLUSION: Although our study was limited to assessing accuracy in a single plane, the results highlighted that surgeons may demonstrate limited accuracy when drilling freehand. Moreover, errors significantly increased during freehand drilling as the desired angle increased. The use of a digital guide significantly increased accuracy with a 4-fold improvement at 45 degrees. Due to its simplicity, no initial training was needed and it can be employed whenever surgeons need precise drill alignment.

Prospective Evaluation of Perioperative Hypothermia in Hip and Knee Arthroplasty

Abstract ID: Poster 046

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INTRODUCTION: Intraoperative normothermia is a goal outlined by multiple surgical guidelines, but limited evidence exists regarding hypothermia's effect in orthopedic patients specifically. The purpose of this study is to prospectively determine the incidence of intraoperative hypothermia in hip and knee arthroplasty with a standardized temperature management and recording protocol, and to evaluate the impact of hypothermia on complications and outcomes.

METHODS: A prospective evaluation of 110 consecutive patients who underwent knee or hip arthroplasty at a single academic hospital between September 2016 and March 2017 using a standardized intraoperative temperature management and recording protocol was performed. Patient demographic data and surgery-specific data were recorded. Incidence of hypothermia was determined and patients were then followed for 12 weeks to monitor for complications. Univariate two-group comparisons are performed using Fisher's exact tests for categorical variables, and using Wilcoxon rank-sum tests for continuous variables. These nonparametric tests are chosen due to small group sizes and non-normal distributions. Statistical significance is set at $p < 0.05$. All analyses are performed using SAS 9.4.

RESULTS: The incidence of mean intraoperative hypothermia was 7.3%. Patients who experienced mean hypothermia spent 39% of the total operative time hypothermic versus 0.9% in the mean normothermic group. Patients with mean hypothermia were noted to have a significantly increased OR and surgical time and higher transfusion rate. Only age was significantly associated with a recorded minimum intraoperative temperature < 36 C. Male gender was a significant predictor of hypothermia in PACU. No other differences were observed regarding complications, outcomes, length of stay, re-admission, or 30-day emergency visit.

CONCLUSION: In this prospective analysis of patients undergoing TKA and THA, increasing age, increased OR and surgical times were associated with development of intraoperative hypothermia. Further patient collection and analysis of data is needed in the future.

Misrepresentation of Research Publications Among Orthopedic Surgery Residency Applicants: Where Are We Now?

Abstract ID: Poster 047

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INTRODUCTION: Two previous studies examining misrepresentation of research publications among orthopedic residency applicants (1999, 2007) revealed rates of misrepresentation at 18% and 20.6%, respectively. Due to the inclusion of the PubMed identification (PMID) number on the Electronic Residency Application Service (ERAS) and the relative ease of finding publications on the internet, we hypothesized that rates of research misrepresentation by orthopedic surgery applicants would be less than previously reported.

METHODS: The PubMed-MEDLINE database was principally used to search for publications listed on the ERAS for applicants applying to one orthopedic residency program. The PMID number was used, and if necessary, a combination of authors or the title of the work. If the citations were not found through PubMed, Ulrich's Periodical Directory was consulted to determine if the listed journal existed. If the journal was not found in Ulrich's Periodical Directory it was excluded from the study. If the journal was found in Ulrich's Periodical Directory, the journal's website was accessed to determine if the article or abstract was present in the respective year and volume provided in the citation. When no match was found, the citation was deemed a misrepresentation.

RESULTS: Our program had 573 applicants for residency in 2016-2017. We found 250 out of 573 applicants (43.6%) did not list a publication, whereas 323 out of 573 applicants (56.3%) listed at least one publication. In total, 323 applicants listed published research with a total of 1100 publications that were reviewed versus 76 reviewed in 1999 and 132 in 2007. We found 13 cases of misrepresentation among those 1100 citations (1.18% in 2017 versus 18% in 1999 and 20.6% in 2007, $p < 0.001$). Ten cases of misrepresentation were self-promotion to a higher authorship status. In one case the applicant claimed authorship of an existing article that did not include the applicant in the author list. There were two cases of claimed authorship of an article that could not be found. Only one applicant misrepresented multiple citations (two citations).

DISCUSSION: Orthopedic surgery residency applicants are, by and large, accurately representing their publication information based on our findings. The incorporation of the PMID number on the ERAS application has streamlined the process for finding publications. This has possibly discouraged misrepresentation on residency applications. Thus, faculty involved in the resident selection process should be less concerned about publication misrepresentation than previously believed.

Orthopedic Surgeons and Statistics: Assessing Resident Attitudes and Knowledge

Abstract ID: Poster 048

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INTRODUCTION: Past medical education systems have failed to prepare medical students and residents in the areas of research design, data analysis, and data interpretation. Coupled with this are reports suggesting 30%-90% of the medical literature contains erroneous application of statistical methods and interpretation. Given the importance of evidence-based medicine, it is crucial that physicians are confident and competent in their abilities to evaluate and utilize medical literature. The purpose of this study is to assess orthopedic residents' knowledge of common biostatistics and research design concepts.

METHODS: We used a validated Biostatistical Knowledge Test Survey Instrument. The survey consisted of two parts. The first part assessed demographics and attitudes towards biostatistics. The second part assessed biostatistics and research design knowledge. Ten orthopedic residency programs were invited to participate in this anonymous survey. Demographics, attitude scores (1 = strongly disagree; 3 = neutral; 5 = Strongly agree), confidence scores (1 = none; 3 = a fair amount; 5 = complete), and test performances were analyzed. Simple descriptive statistics were computed using SPSS 24.0 statistical software.

RESULTS: Overall resident survey completion rate was 65.5% (154/235). Participants were mostly male (84%), aged between 26-30 years (60%), and between 1-3 years of graduating medical school (44%). Over 90% (93%) of respondents "agreed" or "strongly agreed" that some statistics knowledge is necessary to be an "intelligent reader" of medical literature. Over 45% (47.7%) "agreed" or "strongly agreed" that given the chance, they would like to learn more about biostatistics. Less than 20% (16.2%) expressed "a lot of" or "complete" confidence in assessing if the correct statistical test was used for a research question. Over 40% were unable to determine a study's design (45.7%), or apply the concept of specificity and sensitivity (41.2%). Over 80% (80.9%) could not utilize odds ratios in determining the strength of association between two variables. While 78% reported "a lot of" or "complete" confidence in interpreting p values, only 66% correctly answered a question about p values.

CONCLUSION: Notable deficits persist in resident's knowledge of biostatistics and research

design. Majority are not confident in assessing the correctness of a statistical procedure for a research question, but are interested in learning more about biostatistics and research design. Greater effort is needed to improve biostatistics and research design training for orthopedic residents.

Characterizing the Diagnosis and Treatment of Allergic Contact Dermatitis to 2-octyl Cyanoacrylate Utilized for Skin Closure in Elective Orthopedic Surgery

Abstract ID: Poster 049

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INTRODUCTION: While studies have shown that postoperative wound complications can predispose to deep infection following orthopedic surgery, the best form of skin closure has not been elucidated. Further, the unique risks and benefits of each type of wound closure have not been studied extensively. The goal of this study is to present a case series of patients with allergic contact dermatitis (ACD) from of a skin adhesive, 2-octyl cyanoacrylate, utilized commonly in wound closure.

METHODS: Twenty-nine patients with ACD to 2-octyl cyanoacrylate skin adhesive following elective orthopedic surgical procedures from 2013- 2016 were retrospectively reviewed. Mean age was 55 years (range, 15 – 92 years) and there were 21 females (72%). Nineteen patients (66%) had knee operations. We classified patients by symptom severity and treatment requirements into mild, moderate, and severe reactions.

RESULTS: Of 6,088 units of 2-octyl cyanoactylate utilized during the study period, 29 patients experienced an ACD to the skin adhesive, for an estimated incidence of 0.5%. Most reactions were moderate (14/29, 48%) or severe (11/29, 38%) reactions. Mean time from surgery to diagnosis of an ACD was 11.8 days (range, 2 – 42 days). All patients received careful removal of the dressing and daily dressing changes with a specific protocol. Twenty patients (69%) received oral antihistamines, 16 patients (55%) required topical steroids, and 5 patients (17%) required oral corticosteroids. All cases of ACD ultimately resolved at a mean of 22 days (range, 13 – 56 days) postoperatively.

CONCLUSION: 2-octyl cyanoacrylate skin adhesive occurs in an estimated 0.5% of cases and can lead to severe postoperative ACD when used for wound closure following orthopedic operations. However, with early recognition and appropriate treatment, patients' symptoms resolve without a significant impact on wound healing.

Do Higher Volume Hospitals Provide Better Value in Revision Hip and Knee Arthroplasty

Abstract ID: Poster 050

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INTRODUCTION: Previous studies have demonstrated that higher volume hospitals may provide improved care at a reduced cost in primary hip and knee arthroplasty, but the relationship between volume and value in revision TJA is not clear. The purpose of this study is to determine if higher volume centers have lower costs and better outcomes than lower volume hospitals in revision hip and knee arthroplasty.

METHODS: We queried the Centers for Medicare and Medicaid Services (CMS) Inpatient Charge Data and identified 789 hospitals that performed a total of 29,580 revision arthroplasty procedures in 2014. Centers were defined as high (performing over 50 revision TJA per year) or low volume. Mean total hospital specific charges and inpatient payments were obtained from the database and stratified based upon Diagnosis Related Group (DRG). Patient satisfaction scores as well 30-day risk adjusted complication and readmission scores were obtained from the multiyear CMS Hospital Compare database.

RESULTS: Of all the hospitals, 178 (30%) were classified as high volume and performed 15,068 (51%) of all revision TJA cases. High volume centers also performed 509/522 (98%) DRG 466 cases, representing revision TJA cases with major comorbidities and complications. While high volume hospitals had higher Medicare inpatient payments for DRG 467 (\$21,458 vs. \$20,632, $p=0.038$) and DRG 468 (\$17,003 vs. \$16,120, $p=0.011$), there was no difference in hospital specific charges between the groups. Higher volume facilities had a lower CMS risk-adjusted complication score (2.81 vs. 3.00, $p=0.001$) and readmission score (4.36 vs. 4.60, $p<0.001$), and a better CMS hospital star rating (3.63 vs. 3.35, $p<0.001$). When controlling for hospital geographic and demographic factors, high volume revision hospitals are less likely to be in the upper quartile of inpatient Medicare costs for DRG 467 (OR 0.593, 95% CI 0.374-0.941, $p=0.026$) and DRG 468 (OR 0.451, 95% CI 0.297-0.687, $p<0.001$).

CONCLUSION: Hospitals that perform over 50 revision TJA procedures per year have improved outcomes and patient satisfaction scores than low volume centers. While high volume hospitals are less likely to be a high cost outlier, higher mean Medicare reimbursements at these facilities may be a result of increased case complexity. Further study is needed to identify measures for cost savings in revision TJA.

SPORTS

Performance of PROMIS Physical Function Compared with KOOS, SF-36, EQ5D, and Marx Activity Scale in Patients who Undergo ACL Reconstruction

Abstract ID: Poster 051

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OBJECTIVES: PROMIS (Patient-Reported Outcome Measurement Information System) was developed by the National Institutes of Health to advance patient-reported outcome (PRO) instruments by developing question banks for major health domains. We compared responsiveness and construct validity of the PROMIS physical function (PF) computer adaptive test (CAT) with current PRO instruments for patients undergoing anterior cruciate ligament repair.

METHODS: 174 patients completed the PROMIS PF-CAT, Short Form-36 Health Survey (SF36-PF and -GH), Marx activity rating scale (Marx), Knee Injury and Osteoarthritis Score (KOOS-ADL, -Sport, -QOL), and the EuroQol five dimensions questionnaire (EQ5D) before surgery. Surveys were repeated at six weeks and six months postoperative visits. Correlation between instruments was defined as excellent (>0.7), excellent-good ($0.61-0.7$), good ($0.4-0.6$), and poor ($0.2-0.3$) using Spearman Correlation Coefficients. The effect size (Cohen d) and standardized response mean (SRM) were used to describe the responsiveness of each PRO and were defined as small (0.2), medium (0.5), and large (0.8). Ceiling and floor effects were identified if $\geq 15\%$ of participants scored the highest or lowest score on a PRO. Subgroup analyses compared participants with and without additional arthroscopic procedures (meniscal debridement and/or repair, microfracture, or OATS vs ACL repair only) using linear mixed models.

RESULTS: There were excellent and excellent-good correlations between PROMIS PF-CAT and physical function PROs SF36-PF ($r=0.75-0.80$, $p<0.01$), KOOS-ADL ($r=0.62-0.70$, $p<0.01$) and KOOS-Sport ($r=0.32-0.69$, $p<0.01$), and excellent-good correlation with the EQ5D ($r=0.60-0.71$, $p<0.01$) and good correlation with the KOOS-QOL ($r=0.52-0.58$, $p<0.01$). As expected, there was poor correlation with Marx activity ($r=0.24$, $p<0.01$) and the SF36-GH ($r=0.32-0.34$, $p<0.01$). No ceiling or floor effects were noted for the PROMIS PF-CAT and patients answered on average 4 questions. There were no significant differences between subgroups baseline physical function scores, and at follow-up, both subgroups showed improvement in scores were not statistically different.

CONCLUSION: Our results support the construct validity of the PROMIS PF-CAT for ACL repair. Responsiveness to change was highest six months postoperative and greater for the PROMIS PF-CAT than for other measures of physical function with no ceiling or floor effects and a low time-burden. PROMIS PF-CAT therefore is a beneficial alternative for measuring changes in physical function in adults undergoing ACL repair.

High Rate of Missed Lateral Meniscus Root Tears on Preoperative Magnetic Resonance Imaging

Abstract ID: Poster 052

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INTRODUCTION: Lateral meniscus root tears (LMRTs) are clinically important injuries due to their potential effects on articular cartilage degeneration over time and due to the meniscus's role as a secondary stabilizer of the knee. Detection and surgical repair of these defects has been linked to favorable outcomes, but preoperative identification of LMRTs continues to be challenging. The purpose of this study was to determine the rate of LMRTs diagnosed on magnetic resonance imaging (MRI) in a consecutive series of arthroscopically-confirmed LMRTs.

METHODS: A prospective cohort of 45 consecutive arthroscopically-confirmed LMRTs between 2010 and 2017 was included in this study. Medical records of identified patients were reviewed for demographic information, associated injuries, previous operations, and imaging reports. For each patient, the preoperative MRI report, as read by a trained musculoskeletal radiologist, was evaluated and compared to intraoperative findings.

RESULTS: Forty-five patients (32 M, 13 F) with surgically confirmed LMRTs and a mean age of 27 (range: 14-54) were included in the study. 24 (53%) of the LMRTs occurred on the left side. 16 (36%) of 45 LMRTs were diagnosed on preoperative MRI. 28 (62%) of 45 did not correctly identify a posterior root tear or avulsion. Of these, 12 reported a different tear in the lateral meniscus, most commonly in the posterior horn. 1 (2%) MRI reported a focal irregularity of the root of indeterminate significance. Anterior cruciate ligament (ACL) injury or deficiency was present in 36 (80%) of 45 cases. A history of prior surgery in the same knee did not significantly increase the likelihood of missing the LMRT ($p=0.54$).

DISCUSSION AND CONCLUSION: Despite improving identification of other meniscus tear patterns, lateral meniscus root tears are still missed at high rates on preoperative MRIs. Specifically, in cases of ACL tear or revision ACL, the posterior root of the lateral meniscus should be carefully probed at the time of arthroscopy.

Tommy John Surgery and Kerlan-Jobe Orthopaedic Clinic

Abstract ID: Poster 053

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INTRODUCTION: Ulnar collateral ligament reconstruction (UCLR) continues to be a common procedure performed on overhead athletes. Yet, literature is limited to small cohorts or publicly available lists with limited clinical information regarding procedures performed, exams, and medical histories. The purpose of this study was to report on a large cohort of patients that underwent UCLR at a single institution.

METHODS: All patients that underwent UCLR between 2002 and 2014 were included. Charts were reviewed for demographics, inciting history and exams, specific procedure/technique performed, postoperative complications, return to play, and outcomes. Players were then contacted prospectively via telephone to assess outcomes with regards to return-to-play, ulnar nerve symptoms, career performance, and QuickDASH scores. Continuous variable data were reported as weighted means, and categorical variable data were reported as frequencies with percentages.

RESULTS: A total of 616 patients underwent UCLR during the study period (97% male; mean age, 21.25 ± 4.46 years; 79.5% right elbow). The study group was comprised of 95% baseball players, of whom, 83% were pitchers and 12% non-pitchers. Of these patients, 34% were professional athletes, 48% college athletes, and 18% high school athletes at the time of surgery. At the time of injury, 57% of patients had an acute/one pitch UCL tear. Tear location was noted at the humeral origin in 51% of patients, the sublime tubercle in 39% of patients, both proximally and distally in 2% of patients and mid- body in 8% of patients. Surgical technique included 66% modified Jobe, 15% Docking 2 Strand, 12% Docking 3 Strand, 4% DANE TJ, and 2% one tunnel docking with button. Palmaris longus autograft was used in 78% of patients, while gracilis autograft was used in 21% of patients. Partial UCL tears were found in 37% of patients, while complete tears were found in 63% of patients. The ulnar nerve was subcutaneously transposed in 88 (14.3%) patients. 90% of baseball players were able to return to sport. On follow-up, the average QuickDash score was 3.28 and 20 later required revision surgery.

DISCUSSION AND CONCLUSION: This large cohort of predominantly professional and collegiate players showed a return to sport of 90% with very good objective outcome scores.

Glenohumeral Internal Rotation Deficit and Risk of Upper Extremity Injury in Overhead Athletes: A Meta-Analysis and Systematic Review

Abstract ID: Poster 054

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INTRODUCTION: The current perception is that glenohumeral internal rotation deficit (GIRD) is a chronic adaptation that leads to an increased risk of pathologic conditions in the dominant extremity. Our objective was to determine whether adaptations in glenohumeral range of motion in overhead athletes leads to injuries of the upper extremity. s in the dominant extremity.

METHODS: A systematic review of peer-reviewed English language literature evaluating the impact of GIRD in overhead athletes was performed with use of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines and checklists. The search was completed on May 18, 2016, using an explicit search algorithm in the following databases: Medline (1950-May, 18, 2016), Embase (1960-May 18, 2016), SportDiscus (1975-May 18, 2016). Search terms included: GIRD, Glenohumeral internal rotation deficit, Glenohumeral deficit, Shoulder, Sport, Injury, Shoulder Joint, Baseball, Football, Racquet sports, Volleyball, Javelin, Cricket, Athletic Injuries, Throwing injury.

RESULTS: In all, 17 studies met inclusion criteria. This included 2096 subjects (1889 male, 90 female) with an average age of 20.8 years. Shoulders with GIRD trended towards favoring an upper extremity injury with a mean difference of 3.11 (95% confidence interval [CI], -0.13 to 6.36, p-value 0.06). Shoulder total range of motion suggested those with more motion, mean difference 2.97, correlated with no injury ($p = 0.11$) and those with less total motion, mean difference 1.95, favored injury ($p = 0.14$). External rotational gain also trended towards favoring injury with the mean difference 1.93 ($p = 0.07$).

DISCUSSION AND CONCLUSION: The pooled results of this systematic review and meta-analysis showed a trend towards upper extremity injury in overhead athletes with GIRD. Likewise, total rotational loss and external rotational gain show statistical trend towards injury in overhead athletes.

Treatments of Choice for Isolated, Full-Thickness Tears of the Posterior Cruciate Ligament: A Nationwide Survey of Orthopedic Surgeons

Abstract ID: Poster 055

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INTRODUCTION: Treatment for isolated, full-thickness tears of the posterior cruciate ligament (PCL) is controversial. New reconstructive techniques, allograft processing, and long-term outcomes studies have challenged traditional thinking. Debate exists regarding operative indications, surgical approach, graft choice, and rehabilitation protocols. The goal of this study is to determine how the majority of orthopedic surgeons approach and treat isolated, full-thickness tears of the PCL.

METHODS: In June 2017, an internet based survey about PCL reconstruction was distributed via email to orthopedic surgeons in the United States. Responders answered questions related to: demographics, surgical advancements, clinical decision-making, surgical approach, graft choice, and rehabilitation protocol.

RESULTS: The survey was completed by 319 orthopedic surgeons, of whom 91% were fellowship trained in sports medicine. The responders' practices were private (57%), academic (28%), or a mixture (15%). For 88% of surgeons, the number of PCLs reconstructed per year was less than 5, with only 30% of surgeons having reconstructed more than 20 in total. For 86% of surgeons, the PCL is reconstructed in under half of patients. Few responders (10%) stated they will always attempt to repair versus reconstruct the PCL. Allograft and surgical advancements have influenced the decision to reconstruct in only 23% and 35% of surgeons. The most frequently ranked number one or two reasons for pursuing reconstruction were functional limitations (80%) and failure of physical therapy (60%). Most responders prefer the transtibial (69%) or the all-inside (24%) techniques over the inlay technique (7%). Allograft (86%) and single bundle (87%) were favored over autograft and double bundle. The tendons of choice were achilles allograft (53%) and tibialis anterior allograft (17%). Weight-bearing is typically allowed at 4 or 6 weeks (60%), but some surgeons (22%) allow immediate weight-bearing. The brace is most frequently placed in extension (65%), with the rest using dynamic bracing (20%) or 30° flexed bracing (15%).

CONCLUSION: PCL reconstruction is infrequently performed. Less than half of patients with isolated, full-thickness tears are reconstructed, and repair of the PCL is rarely attempted. Allograft and surgical advancements have influenced a modest percentage of surgeons. Functional limitations and failure of physical therapy are the most frequent reasons for pursuing reconstruction. The preferred approach is transtibial with most surgeons using either achilles or tibialis anterior allograft in a single bundle. There is variability in rehabilitation, but most surgeons lock the postoperative brace in extension.

High Grade Cartilage Defects at Time of ACL Reconstruction Affect Rehabilitation and Quadriceps Strength

Abstract ID: Poster 056

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INTRODUCTION: After ACL reconstruction, some patients require longer rehabilitation and others never fully regain quadriceps strength and function. Isolated high grade cartilage defects are often associated with significant quadriceps inhibition, though the effect of these defects in the setting of ACL injury is unknown. The purpose of our study was to determine if there was a correlation between presence of high grade cartilage defects at time of ACL reconstruction and quadriceps strength and rehabilitation postoperatively.

METHODS: 234 patients who underwent primary ACL reconstruction were enrolled (65% male, 35% female, mean age 24.0 SD 8.4). All patients underwent functional strength testing (mean time to evaluation 5.7 months SD 2.4 after surgery). The association between Outerbridge grade 3-4 cartilage defects and isokinetic strength as well as recurrent injury risk was evaluated with adjustment for relevant confounders including demographics, time from injury to surgery, and time from surgery to functional evaluation.

RESULTS: High grade cartilage defects were present in 19% of patients at time of ACLR. Recurrent ACL injury of the reconstructed knee occurred in 8% of total patients and ACL injury of the contralateral knee occurred in 4%. A >80% limb symmetry index was achieved by 65% of patients and >90% in 36% at the initial functional evaluation. Patients with a grade 3-4 defect had a two-folds higher odds of failing to achieve a limb symmetry index of >80% (OR 2.14 CI 1.10, 4.20; $p=0.02$) or >90% (OR 2.08 CI 1.02, 4.55; $p=0.04$) on isokinetic quadriceps testing at time of first evaluation. However, presence of a high grade defect did not increase risk of ACLR graft failure (OR 1.56 CI 0.41, 10.3; $p=0.50$) or risk of contralateral ACL injury (OR 0.76 CI 0.17, 5.29; $p=0.74$).

CONCLUSION: High grade cartilage defects led to a significant decrease in limb symmetry index near 6 months postoperative. Patients with significant cartilage damage at time of surgery may require a more intensive rehabilitation program. However, risk of ACL re-tear or contralateral knee injury is not elevated in these patients once they return to sport.)

Predicting Recurrent Patellar Instability

Abstract ID: Poster 057

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INTRODUCTION: A valid, reproducible, and universally applicable predictor of patellar instability recurrence remains elusive in the literature. Numerous quantitative and qualitative assessments of the unstable patellofemoral joint have been described in an effort to identify pathoanatomy and further stratify a patient's risk for recurrent instability. The goal of this study was to investigate the ability of previously described anatomic risk factors to predict recurrent patellar instability.

METHODS: Eighty-seven patients experiencing a first-time lateral patellar dislocation were identified in a retrospective manner. Magnetic resonance imaging (MRI) studies obtained at the time of injury were reviewed. Skeletal age (closed versus open physis) and presence of trochlear dysplasia (Dejour Classification) was documented. Imaging measurements obtained included the tibial tubercle to trochlear groove distance (TT-TG), Caton-Deschamp ratios, and patellar instability ratios (PIRs). Univariate and multivariate analysis was conducted using a Cox proportional hazards model and Fine-Gray proportional hazards regression, with risk of recurrent instability assessed over a 5-year period.

RESULTS: Thirty-eight of the 87 (44%) patients experienced at least one episode of recurrent instability over a mean 10-year follow-up. Forty-five (52%) of patients were skeletally mature at the time of the index injury. Among those who experienced recurrent instability, 26 (66%) were skeletally immature. BMI ≤ 25 ($p=0.03$), skeletal immaturity ($p<0.01$), patella alta ($p<0.01$), and trochlear dysplasia ($p<0.001$) were identified as statistically significant univariate risk factors for recurrent instability. Trochlear dysplasia was the only risk factor for recurrence that reached statistical significance in the multivariate model. In this cohort, patients with Dejour A and B dysplasia (HR 7.24, $p<0.001$) and Dejour C and D (HR 5.79, $p=0.002$) dysplasia were at a higher risk of recurrence when compared to patients without dysplasia.

CONCLUSION: Efforts to predict recurrent patellofemoral instability are widespread in the literature. This study suggests that features portending a higher likelihood of patellar instability recurrence include skeletal immaturity, normal-to-small body habitus, and patella alta. However, trochlear dysplasia was the only statistically significant risk factor for recurrence at 5-year follow-up identified on the multivariate competing risk analysis. These findings highlight the importance of recognizing a dysplastic trochlea during the initial patient assessment.

Assessment of Elbow Torque in Youth and Adolescent Baseball Pitchers: Fastballs vs. Breaking Pitches

Abstract ID: Poster 058

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BACKGROUND: Previous studies have attempted to calculate the amount of stress across the medial elbow in the adolescent throwing arm using indirect methods. The purpose of our study was to assess the reliability of a new device in measuring torque across the medial elbow of youth and adolescent pitchers during the throwing motion. In addition to this, we aimed to determine the differences in torque across pitch types.

METHODS: The sensor was positioned just distal to the UCL and pitchers were instructed to throw 8 fastballs, 8 curveballs, and 8 change-ups in a standard, randomized sequence. The sensor reported elbow torque, arm speed, arm slot, and shoulder rotation while a radar gun measured peak ball velocity. Precision was calculated by measuring outlier rate, and a multivariable model was performed to detect differences in throwing biomechanics among pitch types.

RESULTS: In total, 20 youth baseball pitchers with an average age of 14.1 ± 1.4 years were included in the study. In measuring elbow torque, the device had a precision of 100% for fastballs, 98.8% for curveballs, and 100% for change-ups. On average, fastballs caused the greatest torque across the medial elbow ($47.3 \text{ NM} \pm 0.5$), compared to changeups ($44.2 \text{ NM} \pm 0.5$; $p < .001$) and curveballs ($45.0 \text{ NM} \pm 0.5$; $p = .002$). Pitchers who started throwing curveballs at an older age were found to experience less elbow torque ($p < .001$). A multivariable model demonstrated that increased ball velocity, shoulder rotation, and arm slot were independent predictors of elbow torque. However, increasing age, higher BMI, longer arm length, and greater elbow circumference were found to be independent protectors against elbow torque.

CONCLUSION: The sensor is a reliable and reproducible device for measuring torque across the medial elbow. Contrary to previous reports in youth pitchers, torque was significantly higher in fastballs than curveballs and change-ups. However, the age a pitcher started throwing curveballs was found to have a significant association with elbow torque. As youth pitchers age and increase in weight and size, there is less torque across the medial elbow.

Performance, Return to Play, and Career Longevity After Tommy John Surgery in Professional Catchers

Abstract ID: Poster 059

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INTRODUCTION: Injury to the ulnar collateral ligament (UCL) of the elbow is a significant injury in high-level throwing athletes. Although reconstruction has shown a high rate of return to play and performance in pitchers, there is limited evaluation of position players, specifically catchers. The purpose of this study was to evaluate return to play, return to level of play, career longevity, and post-injury performance of professional catchers that sustained a UCL rupture requiring surgical reconstruction.

METHODS: A total of 25 professional catchers were identified that underwent UCL reconstruction between 1985 and 2015 and compared to a 1:1 age-, position-, and competition-matched control group. Injury information was collected from publicly available team websites and press releases. Demographic data from each catcher included age at injury, current level of play (Major or Minor League), dominant throwing arm, and career length. Performance statistics were collected from publicly available websites (baseball-reference.com and fangraphs.com).

RESULTS: The average age at time of injury was 24.4 (SD 4.5) years old in the UCL-injured catchers. Return to play for all catchers was 80% (20/25). Of catchers that returned to competition, 95% (19/20) returned to at least the same level of play. For players in the MLB at time of injury, the average time to return to competition (at any level) was 13.6 (SD 5.9) months. Average years in MLB after return was 2.3 years compared to 2.6 years in control group ($p=0.31$) with 4.3 years total (MLB and minors) compared to 3.8 years total in the control group ($p=0.07$). When comparing catchers with UCL reconstruction to the matched control group, there were no significant differences with regards to offensive and defensive performance statistics in almost all categories, both pre- and post-injury, and in comparison to control group. There was a slight increase in slugging % after injury in the UCL catcher cohort compared to controls after injury. Finally, no significant differences were found between the groups for playing time before or after surgery as measured by at bats, games, games started, and innings.

CONCLUSION: Catchers that undergo UCL reconstruction can expect a high rate of return to play with a high rate of return to previous level of play. If able to return to play, catchers should expect no reduction in previous defensive or offensive performance level as well as no change in career longevity after surgery.

Adductor Canal Block vs. Femoral Nerve Block for Pain Control After Anterior Cruciate Ligament Reconstruction: A Prospective Randomized Trial

Abstract ID: Poster 060

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INTRODUCTION: Regional anesthesia in the form of a femoral nerve block (FNB) is a commonly performed technique that provides adequate analgesia following ACL reconstruction. The adductor canal nerve block (ANB) employs a similar sensory block around the knee while avoiding motor blockade of the quadriceps. The purpose of our study was to compare the efficacy of FNB versus ANB for pain control following ACL reconstruction. Our hypothesis was that there would be no difference in pain levels between the two procedures.

METHODS: We performed a prospective, double-blinded, randomized controlled trial. Eighty patients undergoing primary ACL reconstruction using bone-tendon-bone (BTB) autograft were randomized to receive either an ANB or FNB preoperatively. The primary outcomes measured were pain levels (visual analog scale) and narcotic requirements for 4 days following surgery. Secondary outcomes included ability to perform a straight leg raise in the recovery room and difference in thigh circumference between the operative and non-operative leg measured at 7 days postoperatively.

RESULTS: There was no difference in pain scores or narcotic requirements between the two treatment groups postoperatively. Patients receiving a FNB had more rebound pain and required more pain medications as the block wore off (21-24 hours, $p=0.048$). The ability to perform a straight leg raise in the recovery room and difference in thigh circumference at first postoperative visit also did not differ between treatment groups.

CONCLUSION/DISCUSSION: The results of our study suggest similar efficacy in peri-operative pain control with the use of an ANB for ACL reconstruction when compared to FNB. Adductor canal nerve block is an adequate alternative option for pain control following ACL reconstruction with decreased rebound pain.

Preoperative Ultrasonography is Unreliable in Predicting Hamstring Tendon Graft Diameter for ACL Reconstruction

Abstract ID: Poster 061

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BACKGROUND: Hamstring autograft size less than 8 mm has been shown to be a predictor for failure after anterior cruciate ligament (ACL) reconstruction. The ability to predict graft size preoperatively is helpful in counseling patients about the possible need for graft augmentation.

PURPOSE: To determine if preoperative US measurements of hamstring tendons can predict intraoperative graft diameter during ACL reconstruction.

STUDY DESIGN: Cohort study (diagnosis); Level of evidence, 2.

METHODS: Twenty patients (mean age = 22.8 ± 6.6 years; mean height = 175.1 ± 7.1 cm; mean weight = 81.4 ± 14.2 kg; BMI = 26.5 ± 4.1 ; 10 female) undergoing unilateral isolated ACL reconstruction were prospectively enrolled in the study. Hamstrings were assessed by ultrasound, and double looped semitendinous gracilis hamstring size was independently calculated using a freehand selection method on a non-magnified ultrasound image (ImageJ software, NIH.gov) by two orthopedic surgeons. Intraoperative autograft size was determined using a standard graft sizing tool. Intra/inter rater reliability was measured by interclass correlation coefficients (ICC) and standard error of the measure (SEM). A Receiver Operating Characteristic (ROC) curve was calculated to assess the ability of the ultrasound measurement to predict intraoperative measurements.

RESULTS: The mean autograft diameter by ultrasound was 8.9 ± 0.98 mm while the mean intraoperative hamstring graft size was 8.1 ± 0.89 mm. There was excellent intra (ICC [2,1] = 0.95; SEM = 0.32 mm) and inter rater (ICC [2,1] = 0.88; SEM = 0.55 mm) reliability for US measurements. ROC analysis showed that US did not consistently quantify graft size. Graft size did not significantly correlate with height, weight, or BMI in our sample ($P > 0.05$).

CONCLUSION: These results suggest that preoperative ultrasound imaging of the hamstring tendons is unreliable in predicting intraoperative graft diameter.

HIP

Selecting Appropriate Candidates for Outpatient Total Joint Arthroplasty: A Validated Selection Algorithm

Abstract ID: Poster 062

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INTRODUCTION: Total joint arthroplasties (TJA) of the hip, knee, and shoulder are successful surgical procedures that yield predictable outcomes and are increasing in frequency. Though TJA has traditionally been associated with an inpatient hospital stay, this has been challenged by recent pressure from regulations to reduce costs and improve quality. Studies suggest that TJA can be performed safely and with good outcomes on an outpatient basis, but identifying those TJA patients who are good outpatient candidates remains challenging. In this study, we propose a patient selection algorithm for selecting outpatient TJA candidates with validation by a cohort of patients from our ambulatory surgery center.

METHODS AND MATERIALS: Patients who underwent primary total shoulder, hip, or knee arthroplasty at a single outpatient center were identified. These patients were selected by utilizing our proposed selection algorithm, managed by the treating surgeon and anesthesiologist. 172 joints were identified, composed of 89 total hip arthroplasties (THA), 49 anatomic total shoulder arthroplasties (TSA), 22 total knee arthroplasties (TKA), and 12 reverse total shoulder arthroplasties (RTSA). The cohort was evaluated for demographic characteristics as well as postoperative complications. Acute blood loss, transfusion, wound complications, UTI, bowel incontinence, and reoperation were considered to be surgical complications. Non-surgical/cardiopulmonary complications were defined as mortality, arrhythmia, blood pressure dysfunction, syncope, thromboembolic events, pneumonia, renal failure, any other substantial deviation from the typical postoperative course not attributable to direct effects of surgery.

RESULTS: Postoperatively, 14 patients (8% of the cohort) experienced nausea, and one patient had documented emesis. All of these patients received anti-emetic treatment per post-anesthesia protocol, and all were discharged from the surgery center on the day of operation. A total of six patients (3% of the cohort) experienced a complication intraoperatively or postoperatively, with two patients necessitating transfer to an inpatient setting and one requiring reoperation. Two patients experienced syncope, with one of these patients requiring transfer to the hospital for acute blood loss anemia. A second patient required hospitalization for management of acutely uncontrolled blood glucose postoperatively. Other complications included post-surgical blood loss with hematoma formation requiring delayed evacuation, and acute bradycardia.

CONCLUSION: Use of this patient selection algorithm produced low complication and unplanned admission rates. Our algorithm provides a method for the standardization of outpatient TJA candidate selection, aiding physicians seeking an evidence-based method of evaluation for patients interested in TJA in an ambulatory setting.

Dual Taper Modular Hip Implant: Investigation of 3D Surface Scans for Component Contact, Shape, and Fit

Abstract ID: Poster 063

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INTRODUCTION: The purpose of this study was to conduct three dimensional (3D) surface scans of the mating surfaces of the neck-stem taper to identify features that may contribute to the fretting and surface corrosion.

METHODS: Eighteen modular hip implant components (9 stems and 9 necks) received 3D surface scans to examine the neck-stem taper junction. The study analyzed the neck-stem taper in an as assembled condition so relative surface positions and surface features could be studied. The 9 stems and 9 necks were scanned using an optical scanner resolved to a point spacing of 0.5 mm. Measurements included contact mapping, contour plots, taper angles, and neck insertion depths. While contact mapping and contour plots provided a cross-sectional understanding of component fit, angle and depth measurements provided additional information on component fit in the third dimension.

RESULTS: The plot colors show contact proximity ranging from 0 - 0.025 mm, 0.025 - 0.050 mm, and 0.050 - 0.075 mm. The average neck seated depth in the stem was 14.181 mm, ranging from 13.796 mm to 14.422 mm. Regression analysis showed that the seated depth of the neck was dependent on the taper angles in the flat section of the neck ($R^2 = 0.5000$, $p = 0.0332$). The typical features observed in these contact maps were: (1) a distinct vertical line of contact at one end of the transition from the flat to the radius surface; (2) a concavity along the flat surface between the neck and stem components; and (3) one of the neck flat surfaces was closer to its mating surface on the stem.

CONCLUSIONS: Three dimensional analysis suggest that the shape of the neck and stem tapers deviate from ideal design dimensions, resulting in a contact pattern with gaps between the mating surfaces and rotated alignment. The probable cause of the dimensional deviation is due to machine tool deflection during manufacture. The combination of the contact and fit is expected to contribute to relative motions between the neck and stem, exacerbating the MACC.

Outcome of Total Hip Arthroplasty in HIV-Positive Patients Managed with Contemporary Protocols

Abstract ID: Poster 064

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INTRODUCTION: Osteonecrosis of the femoral head is a well-recognized complication in patients with Human Immunodeficiency Virus (HIV) infection. Some patients would require total hip arthroplasty (THA) surgery. Highly active anti-retroviral therapy has increased the life expectancy of the HIV-positive patients. Most of the previously reported data of THAs in the HIV-positive patients were from the 1990s. The purpose of this study is to evaluate the outcome of a consecutive series of THAs performed in HIV-positive patients who were managed with the contemporary therapy protocols.

METHODS: Eighty-four HIV-positive patients underwent 101 THAs from 2004 to 2014 in an urban teaching hospital. Among these, 42 patients (56 THAs) have complete records with a minimum 2-year follow-up. The average follow-up was 59 months (24- 114). All cups and stems were inserted using cementless fixation. All bearing couplings were metal-on-poly (highly cross-linked poly).

RESULTS: There were 6 females and 36 males with an average age of 51 (35 to 65). The average BMI was 27.3 kg/m². The average CD4 count was 572 (132 to 1407) and the viral load was undetectable in 29 patients at the time of THA. Average viral load in the remaining 13 patients was 12,938 copies/mL. The mean length of stay was 3 days (2 to 7). Three patients required revision surgery. One cup revision was done due to recurrent dislocation (shell revision to accommodate constrained liner), and 2 stem revisions were done due to fixation loosening. Three patients underwent reoperations without removal of implants. Radiographic evaluation demonstrated no sign of fixation loosening, or articulation wear with associated adverse bone remodeling in any of the hips at final follow-up.

CONCLUSION: The overall complication rates in the HIV-positive patients undergoing THAs have been reported to be as high as 50%. Infection has been cited as one of the failure mechanisms. The overall reoperation rate in this series was 10.7%. There was no peri-prosthetic infection. There was one case of non-surgical wound cellulitis, making the infection rate (1.8%) considerably lower than those reported in earlier studies. We believe this finding was due to the improved medical management. The mechanisms of failure in this series were similar to those of the THA population with osteonecrosis from other causes. Continued monitoring for late infections, mechanical wear, and loosening is important to establish the long-term outcome in this unique patient population.

PROMIS Physical Function and Pain Interference Computer Adaptive Testing Correlates Well with Modified Harris Hip Score in Total Hip Arthroplasty

Abstract ID: Poster 065

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INTRODUCTION: The Modified Harris Hip Score (mHHS) is a validated and disease specific instrument commonly used to assess outcomes in total hip arthroplasty (THA). PROMIS (Patient Reported Outcome Measurement Information System) is a validated global health assessment tool developed by the NIH. Our goal is to compare PROMIS to the Modified Harris Hip Score in patients undergoing THA.

METHODS: Patients were prospectively enrolled in the study. All THAs were performed via the direct anterior approach by a fellowship-trained arthroplasty surgeon at a single center. A standardized, protocolled approach to anesthesia, blood management, VTE prophylaxis, pain management, and physical therapy was followed. Patients completed and Modified Harris Hip Score preoperatively, and at 3 weeks, 6 weeks, and 12 weeks postoperatively. Student's t-test and Pearson correlation coefficients were used. Statistic analysis was completed using SAS Enterprise Guide v6.1.

RESULTS: A total of 48 patients were prospectively enrolled in the study, 46 of which (96%) completed all assessments at all time points. PROMIS measures are on a 0-100 scale, with the population mean set to 50, and one standard deviation set to 10. Preoperatively, PROMIS Physical Function and Pain Interference scores were greater than one standard deviation worse than the population norm (37.3 and 36.9, respectively). Preoperatively, the total PROMIS score (Pain Interference and Physical Function) was 74.2 and the average Modified Harris Hip Score was 50.8. Preoperatively, the total PROMIS score showed a moderate correlation ($r=0.56$, $p < 0.001$) with total mHHS.

Postoperatively, the mean total PROMIS score at 3, 6, and 12 weeks was 82.4, 93.4, and 100, respectively ($p < 0.001$, interval change at all 3 time points). Postoperatively, the modified Harris Hip Score at 3, 6, and 12 weeks was 68.2, 81.1, and 85.9, respectively ($p < 0.001$, interval change at all 3 time points). At 3, 6, and 12 weeks postoperatively, there was a strong and consistent correlation between total PROMIS and mHHS ($r=0.74$, $r=0.74$, $r=0.73$, respectively, $p < 0.001$).

CONCLUSION: PROMIS scores are significantly worse than the population norm preoperatively, and nearly normal at 12 weeks postoperatively. Preoperatively, total PROMIS score has a moderate correlation with total Modified Harris Hip Score, with disagreement likely related to a floor effect with the mHHS. At all time points postoperatively, total PROMIS demonstrated a strong and consistent correlation with total mHHS. Combined PROMIS Pain Interference and Physical Function scores are a reasonable measure of outcome in THA.

PROMIS (Patient-Reported Outcomes Measurement Information System) Physical Function and Pain Assessments Are Valid Outcome Measures in Total Hip Arthroplasty as Compared to Legacy Measures

Abstract ID: Poster 066

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INTRODUCTION: Patient-reported outcome measures are an important part of understanding the value of a given surgical intervention but can be cumbersome, costly, and time consuming to collect on a large scale. Patient-Reported Outcomes Measurement Information System (PROMIS) is a newer tool that is psychometrically and statistically valid. PROMIS is a set of computer adaptive tests (CATs) that measure physical function, pain, and pain-related behavior with less time and fewer questions. However, little data is available directly comparing PROMIS to legacy outcome measures.

METHODS: Ninety-two prospectively enrolled patients undergoing THA were administered PROMIS CATs for Physical Function, Pain Interference, and Pain Behavior as well as legacy measures (HOOS, UCLA activity score, EQ-5D, and VR-12) preoperatively and postoperatively at 6, 12, 24, and 52 weeks. Instruments were examined for ceiling and floor effects at all time points. Pearson correlation coefficients were used to measure correlation between PROMIS CATs and legacy measures. We used Student t-tests to assess responsiveness to change.

RESULTS: Baseline pre-THA PROMIS means were 1 to 1.5 SDs worse than the general population. PROMIS CATs had a moderate to strong correlations with the VR-12 Physical scale, the EQ-5D, HOOS Pain, HOOS ADL, HOOS Sports/Recreation (with Pain Interference and Physical Function only), and were responsive to change following surgery. PROMIS CATs had minimal floor and ceiling effects at baseline that diminished by 12 weeks postoperative. PROMIS CATs were completed quickly (mean=3.1 minutes for Pain Behavior, Pain Interference, and Physical Function). Other measures required more time (VR-12=3.4 minutes, HOOS=5.6 minutes).

CONCLUSIONS: PROMIS Physical Function, Pain Interference, and Pain Behavior CATs were completed with in less time, and demonstrated moderate to strong correlation with legacy measures for pain and physical function assessment. PROMIS displayed responsiveness to change and minimal floor and ceiling effects in patients undergoing THA.

Short-Term Outcome of a Tri-Tapered Femoral Stem in Direct Anterior Total Hip Arthroplasty

Abstract ID: Poster 067

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BACKGROUND: Direct anterior approach (DAA) of total hip arthroplasty (THA) has become increasingly more popular among arthroplasty surgeons, in large part due to its utilization of a true internervous and intermuscular plane. With growing interest in utilization of the anterior approach, it is important to demonstrate equivalent or better results in component positioning and fixation compared with more traditional approaches. A proximal metaphyseal filling femoral implant, with its short and curved shape, facilitate femoral component insertion and positioning when using the DAA. We aimed to evaluate subsidence of a tri-tapered femoral stem implanted utilizing an anterior approach, and to evaluate the rates of subsidence in bone with varied proximal femora bone quality.

METHODS: A retrospective analysis of 155 consecutive primary THA performed by a single fellowship-trained orthopedic surgeon (TB) between July 2014 and January 2016 were evaluated. Age, gender, primary diagnosis, and radiographic measurements were recorded for each study patient. Radiological evaluation, such as bone quality, femoral canal fill, implant subsidence, and implant alignment, were measured on standardized anteroposterior (AP) and frog leg lateral radiographs of the hip at 6-week and 6-month clinical follow-up, utilizing a commercially available picture archiving and communication system (PACS). The radiographs were analyzed by independent examiners, who were not involved in the care of the patients.

RESULTS: There were no significant cases of femoral stem subsidence with an average subsidence of 1.18 ± 0.83 mm. Additionally, there was no statistical difference in the amount of subsidence based on gender, age, diagnosis, or proximal femora quality (p-value of 0.05). The tri-tapered stem design consistently filled the proximal canal with an average of $91.31 \pm 4.58\%$ fill.

CONCLUSIONS: Arthroplasty utilizing a direct anterior approach and a tri-tapered femoral stem can achieve a consistent and reliable fit regardless of proximal femora quality equal to results with traditional approaches.

Preoperative Opioid Use Independently Predicts Increased Risk of Early Revision of THA

Abstract ID: Poster 068

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INTRODUCTION: There has been little research evaluating the effects of preoperative opioid use on the need for subsequent surgery after primary total hip arthroplasty (THA). The purpose of this study was to evaluate the impact of preoperative opioid use on the risk of early THA revision.

METHODS: The Humana database was queried for primary THA during the years 2007-2015. Patients were tracked for the occurrence of an ipsilateral revision THA within 2 years following the index procedure. Factors analyzed for risk of early revision of THA included preoperative opioid use, age (<50 vs. ≥ 50 years), sex, diabetes, anxiety/depression, chronic kidney disease (CKD) and obesity (BMI > 30kg/m²). Preoperative opioid use was defined as a history of opioid prescription filled within 3 months prior to primary THA. Multivariate logistic regression analysis was utilized to determine odds ratios (OR) and corresponding 95% confidence intervals for risk of early revision after primary THA.

RESULTS: In total, 17,695 primary THA patients were analyzed and 0.8% (n = 155) had a revision THA procedure within 2 years of the index surgery. Overall, 36.7% of patients had filled an opioid prescription within 3 months prior to THA and met criteria for an opioid user. Female to male ratio was approximately 2:1 and 79.7% of patients were >50 years at time of surgery. Eighteen percent of patients were obese, 27.7% were diabetic, 9.4% were smokers, 12.9% had CKD and 6.0% had anxiety or depression. Multivariate logistic regression demonstrated preoperative opioid users were significantly more likely to undergo early THA revision than non-opioid users (1.2% vs. 0.7%, OR 1.5 [1.1-2.1], p=0.01). Other patient factors that also significantly increased the risk of early THA revision included obesity (1.3% vs. 0.8%, OR 1.5 [1.03-2.2], p=0.03) and anxiety/depression (1.9% vs. 0.8%, OR 2.0 [1.2-3.2], p = 0.006).

DISCUSSION: This study identified that opioid use within three months prior to THA independently predicts an increased risk of early revision surgery. This finding provides further support for national efforts to decrease unnecessary and inappropriate opioid prescribing. Further research is needed to evaluate if discontinuing opioids prior to surgery mitigates this risk.

The Use of Intraoperative Manufactured Articulating Antibiotic Hip Spacers: A Novel Technique to Treat Infection in a Cost Conscious Environment

Abstract ID: Poster 069

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INTRODUCTION: Two-stage revision surgery remains the gold standard as treatment for periprosthetic hip infections. The purpose of this study was to determine the rate of infection eradication after two-stage revision hip arthroplasty in patients treated with articulating spacers constructed in the operating room as well as to compare the economical impact of custom-made articulating antibiotic spacers to those commercially available.

METHODS: Thirty-six patients who underwent two-stage revision hip arthroplasty due to chronic periprosthetic infection between 2003-2014 were followed clinically and radiographically an average of 4.9 years postoperatively (2.2-9.2). 17 male and 19 female patients with a mean age of 62 [34-82] had articulating spacers, made in the operating room, inserted at the first stage. The overall expense of the custom-made antibiotic spacers and the commercially available spacers was calculated and compared using a student t-test.

RESULTS: Thirty-one patients (86.1%) had no clinical or radiographic signs of infection at the time of most recent follow-up. There were no periprosthetic femur fractures and only one (2.8%) had a dislocation of hip spacer prior to the second stage surgery. After reimplantation, five patients (13.9%) suffered dislocations of the prosthetic hip. The antibiotic articulating hip spacer manufactured intraoperatively cost \$2,712 as compared to commercially available injectable molds \$4,619 ($p<0.05$) and prefabricated spacers \$3,820 ($p<0.05$).

CONCLUSIONS: Patients treated using custom-made articulating spacers had similar infection eradication rates and outcomes compared to previously reported commercially available articulating spacers. In the era of cost containment and surgical bundles, the use of custom-made articulating spacers should be considered in the first stage of periprosthetic infections. Compared to the overall cost of an injectable mold, a custom-made articulating antibiotic spacer provided a cost savings of \$69,000 for this series of patients and represent a potential national savings of over \$25 million dollars annually.

Total Joint Arthroplasty in Patients with Schizophrenia: How Much Does it Increase the Risk of Complications?

Abstract ID: Poster 070

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INTRODUCTION: Mental illness is an often overlooked comorbidity in the total joint arthroplasty (TJA) population. The purpose of this study was to evaluate the risk of schizophrenia on the outcomes of TJA.

METHODS: The nationwide inpatient sample (NIS) was used to identify a cohort of 505,840 patients having total hip arthroplasty between 2009 and 2012, of which 953 patients (0.2%) had been diagnosed with schizophrenia. Multivariate logistic regression was used to identify the impact of schizophrenia on medical and surgical complications in a 90-day postoperative period. Differences in length of stay and discharge disposition were also compared.

RESULTS: Schizophrenic patients are more than 20 times more likely to have pulmonary insufficiency following surgery (OR 20.6, $p < 0.0001$). Patients were more than four times more likely to become septic (OR 4.2, $p = 0.0132$), nearly six times more likely to have mental status changes (OR 5.6, $p < 0.0001$), and two times more likely to require a transfusion (OR 2.1, $p < 0.0001$) or develop a hematoma (OR 1.9, $p = 0.0333$). All-cause medical (OR 2.0, $p < 0.0001$), and surgical complications in schizophrenic patients (OR 1.5, $P < 0.0001$) were higher. Patients stayed an average of 0.63 days longer in the hospital (3.85 days vs. 3.22 days, $p < 0.0001$), and were nearly three times more likely to discharge to a facility postoperatively (OR 2.7, $p < 0.0001$).

CONCLUSIONS: Total joint arthroplasty in patients with schizophrenia is wrought with medical and surgical complications. Particularly, pulmonary complications, transfusion and hematoma rates are possibly related to antipsychotic medications. Patients and family should be counseled regarding these risks. Future risk adjustment models should include schizophrenia as a major contributor to increased medical and surgical complications. This is important data when considering bundling and other quality based initiatives.

SUMMARY: Patients with the diagnosis of schizophrenia are at high risk (4-20 times) for pulmonary insufficiency, sepsis, and need for transfusion following THA.

Key Words: Total hip arthroplasty; Schizophrenia; Pulmonary complications; Blood transfusion; Facility discharge

Does Gender Really Influence the Risk of Complications Following Total Joint Arthroplasty?

Abstract ID: Poster 071

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INTRODUCTION: Recent literature has begun to suggest that male sex is an independent risk factor for complications following total joint arthroplasty (TJA) procedures. However, these studies do not take into account the published association between male sex and longer TJA operative times. Therefore, the purpose of this study was to use a large multi-center database to identify whether male gender remains a risk for postoperative complications following TJA while controlling for operative times.

METHODS: The American College of Surgeons National Surgical Quality Improvement Program database was queried from 2011-2013 to identify all patients who underwent primary total hip (THA) or total knee arthroplasty (TKA). Male and female patients were compared in terms of demographics, comorbidities, procedure type (THA or TKA), and operative time (<120 minutes vs. ≥ 120 minutes) to determine the impact of these variables on 30-day postoperative complications. A multivariate logistic regression analysis was performed to control for confounding variables and determine if gender remained an independent predictor of complications. Primary outcomes included mortality, reoperation, and deep infection.

RESULTS: There were 99,311 patients identified who underwent TJA during 2011-2013. Of these, 40% were male and 60% females. The average age at time of surgery was 66.4 ± 10.7 years. The overall incidence of 30-day complications after TJA was 5.1%. Males had significantly higher rate of diabetes (16.5% vs. 14.2%), smoking (11.6% vs. 9.3%), coronary artery disease (0.4% vs. 0.3%), and preoperative dialysis (0.3% vs. 0.1%, $p < 0.01$ for all). Univariate analysis stratified by sex demonstrated that males were at an increased risk for deep infection (0.2% vs. 0.1%, $p = 0.002$), reoperation rate (1.6% vs. 1.3%, $p < 0.001$), and mortality (0.2% vs. 0.1%, $p = 0.008$) compared to females. Multivariate regression analysis controlling for operative time, patient demographics, and comorbidities demonstrated no significant differences between men and women for odds of deep infection (odds ratio OR 1.0 [0.9-1.2]), or mortality [OR 1.0 [0.9-1.1]] after TJA.

CONCLUSIONS: Men have long been reported to be at increased risk complications following TJA. However, men have also been linked to increased operative times theorized to be due to the increase muscle size and larger soft tissue envelope as compared to their female counterparts. This study demonstrates that when controlling for operative time, men were at no greater risk for infection, or mortality following TJA when compared to females. The disparity and risk profile between men and women appears to be related more to the difference in operative time than to the underlying physiology differences between sexes.

Acetabular Cup Placement at the Anatomic Hip Center Promotes Long-Term Durability in Cemented Total Hip Arthroplasty in Patients with Crowe Type-III Dysplasia: A 35-Year Follow-Up Report

Abstract ID: Poster 072

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INTRODUCTION: We previously reported the mid-term results of 70 cemented total hip arthroplasties (THAs) performed from 1969 to 1980 in patients with Crowe type-III dysplasia. The purpose of this study was to update the long-term effects of acetabular cup position on acetabular and femoral component loosening and survival free from aseptic revision in this cohort.

METHODS: Utilizing our total joint registry, we retrospectively reviewed the original series of 70 hips in 65 patients. Preoperative radiographs were assessed to confirm patients with Crowe type-III dysplasia prior to THA. Initial postoperative radiographs were reviewed to assess acetabular cup placement. Criteria for assessment included positioning (1) within 15 mm of the approximate femoral head center (AFHC), (2) within 35 mm of the inter-teardrop line (ITL), (3) within the true acetabular region (TAR), and (4) by location within a four-zone system. Given the long follow-up period, competing risk analysis was used to determine the 35-year cumulative incidence of both acetabular and femoral component loosening and aseptic revision with other-cause revision and death as competing risks. Clinical outcomes were assessed using Harris hip scores (HHS).

RESULTS: Of the initial 65 patients, 25 (28 hips) were alive with a minimum 35-year follow-up. The overall cumulative incidence of loosening and/or aseptic revision was 64% for acetabular components and 31% for femoral stems. Both acetabular and femoral component loosening and aseptic revision were less likely with cup placement <15 mm from the AFHC, <35 mm from the inter-teardrop line ITL, within the TAR, or within zone 1.

CONCLUSION: Acetabular cup placement at the anatomic hip center was associated with significantly lower rates of loosening and aseptic revision for both acetabular and femoral components. These results favor placement of the acetabular component at the anatomic hip center to promote long-term durability in cemented total hip arthroplasty.

SUMMARY: Rates of acetabular and femoral component loosening and aseptic revision were significantly lower with acetabular cup placement at the anatomic hip center in cemented THAs performed for Crowe type-III dysplasia.

Preoperative Anticoagulant Therapy in Total Joint Arthroplasty and Clinical Outcomes

Abstract ID: Poster 073

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PURPOSE: Complications after total hip and knee arthroplasty (THA/TKA) are a multifactorial problem with potentially significant consequences to the patient, including morbidity and mortality as well as the associated financial cost to the healthcare system. Anticoagulants are used for a variety of indications and their use in this patient population is widespread. The purpose of this study was to determine the effect of preoperative anticoagulant therapy on postoperative outcomes in total joint arthroplasty.

METHODS: We performed a retrospective cohort analysis of 663 patients (388 TKAs, 275 THAs) with a history of TJA at a university-affiliated tertiary medical center in Southeast Michigan from February 2014 to December 2015. All data were standardized and collected for inclusion in the Michigan Arthroplasty Registry Collaborative Quality Initiative (MARCQI). Information included patient demographics and a Charlson Index. After univariate two-group compilation the study focused on multivariate comparison using significant associations through chi-square tests for categorical variables and a two-way analysis of variance with post-hoc Fisher's LSD tests for continuous variables. Patients on preoperative anticoagulation prior to surgery were compared to those that were not. The study employed an alpha of 0.05 for main effects, 0.10 for interactions, and 0.05 for post-hoc tests. All analyses used SAS 9.4 and SigmaPlot 12.3.

RESULTS: There were 47 patients that were on preoperative anticoagulation prior to total joint arthroplasty (28 TKAs, 19 THAs) and 616 who did not (360 TKAs, 256 THAs). Overall, patients on preoperative anticoagulant therapy were older (71.9 +/- 10.6 versus 65.6 +/- 10.6; $p < 0.001$). Controlling for age, BMI and Charleson Index, patients on preoperative anticoagulation were found to have a longer than median length of stay (OR 2.81, CI 1.50-5.25; $p = 0.001$), and a higher rate of transfusion (OR 2.29, CI 1.16-4.52; $p = 0.017$). There were no statistically demonstrable differences among the groups in regards to rates of readmission, emergency room visits, infection, DVT, PE, or death.

CONCLUSION: This retrospective review identified the association of preoperative anticoagulant therapy with worse clinical outcomes following total joint arthroplasty, including a higher length of hospital stay as well as a higher rate of blood transfusion postoperatively.

Human Synovial Fluid vs. Bovine Calf Serum: A Hip-Load of Friction

Abstract ID: Poster 074

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SHORT SUMMARY AND SIGNIFICANCE: A new friction measurement machine is introduced which is able to produce the pressures and sliding speeds that hip implants must endure, and shows that human synovial fluid outperforms bovine calf serum in in vitro friction tests of UHMWPE on CoCr.

INTRODUCTION: Reducing friction in orthopedic joint replacements is crucial to the long-term survival of the implant. High friction has been associated with implant failure due to loosening, especially in metal-on-metal hips. High friction has also been a suspect in causing the trunnion corrosion at the head-taper interface in total hip replacements. Additionally, this corrosion or high wear of metallic surfaces can cause an increase in metal ions, which can cause metallosis, and especially severe symptoms in metal sensitive patients. Because the friction is so critical, one can imagine that the lubricant plays a major role in the in vitro friction and wear of total joint replacements. In the body, synovial fluid is the naturally occurring lubricant, and therefore finding a lubricant that is similar to human synovial fluid is necessary for accurate in vitro testing of implants. This surrogate lubricant, rather than actual human synovial fluid, must be used in in vitro testing as it is unfeasible to collect and preserve a sufficient quantity of synovial fluid. It is widely accepted that bovine calf serum is a good surrogate lubricant, as it is thought that the frictional properties bovine calf serum closely resemble those of human synovial fluid. However, little testing has been done to compare the frictional properties of bovine calf serum and human synovial fluid under both physiologically relevant hip pressures and sliding speeds.

METHODS: Bovine calf serum diluted with DI water to two different protein concentrations (15 g/L, and 30 g/L) and pure undiluted serum (71 g/L) as well as human synovial fluid were used as lubricants in friction testing (37° C for all). The human synovial fluid was harvested at the time of total knee replacement surgery at the University of Nebraska Medical Center (IRB approved). Ultra-high molecular weight polyethylene pins were machined from GUR 1050 bar stock (conventional, non-crosslinked material). The pins were 6 mm in diameter, and 19 mm in length. Highly polished CoCrMo disks ($R_a: 0.04 \pm 0.01 \mu\text{m}$, verified with an Ambios non-contact interferometer) were rotated underneath the pins on a custom-built friction machine. The friction machine had two dedicated load cells, one to measure the axial compressive load, and another to measure the frictional torque. As a pin was pressed against a disk at a known distance from the disk center (9.5 mm) and the disk was rotated, the pin would “want” to move due to contact with the disk. This pin assembly movement was allowed by a frictionless air bearing (unique to this machine), but was prevented by an adjustable lever arm that connected to a torque cell. With a known lever arm length (0.665 m), the frictional force was computed dynamically, and divided by the axial load to determine the friction coefficient in real time. The samples were tested at two sliding speeds, 0.05 mm/s to measure the static “break away” friction coefficient, and 20 mm/s to measure the dynamic friction coefficient (20 mm/s is within the anatomic sliding speed range for a 40mm diameter hip replacement). The pin samples were pressed against the

disks with 5 MPa (~140 N), which is in the anatomic range for hip replacements (and 500x higher than another friction study [1]). One experiment was conducted at 2 MPa as well. For all experiments, N=3.

RESULTS: In all cases, the static friction coefficient was higher than the dynamic friction coefficient, as was expected. In the static test, the only significant difference in friction was between the serum diluted to 15 g/L protein (0.101 ± 0.008) and the much lower friction synovial fluid (0.040 ± 0.006 , $p = 0.0006$). In the dynamic tests, the 2 MPa test with standard serum (30 g/L protein) showed a higher dynamic friction coefficient than the same test at 5 MPa (0.056 ± 0.004 , 0.036 ± 0.006 , respectively, $p = 0.012$). At 5 MPa, the standard serum showed no difference in friction when compared to the diluted serum ($p = 0.877$), but showed higher friction than the pure undiluted serum ($p = 0.031$) and the synovial fluid ($p = 0.021$). Pure, undiluted serum showed similar friction to the synovial fluid in both the static test (0.057 ± 0.030 , 0.040 ± 0.006 respectively, $p = 0.417$) and the dynamic test (0.022 ± 0.003 , 0.019 ± 0.003 respectively, $p = 0.387$).

DISCUSSION: It was interesting that increasing the pressure from 2 MPa to 5 MPa caused a drop in friction coefficient. Perhaps under the higher load, the UHMWPE pin material deformed and spread out which made the pressure distribution more uniform, reducing the local high pressure asperities where contact between the pin and disk would occur. In general, increasing the protein concentration of the serum resulted in a reduced friction coefficient, approaching the measured friction value of synovial fluid in the case of the pure, undiluted serum. The synovial fluid showed very low friction coefficients in both the static and dynamic tests. It appears that synovial fluid out-performs bovine calf serum in terms of friction. Perhaps this means that in vitro wear testing of joint replacements with diluted bovine serum is a “worst case scenario” as far as lubrication is concerned, or at least sub-optimal. Additionally, perhaps this means that joint replacements are faring better in vivo than what we are able to predict through in vitro wear testing with diluted bovine serum.

References:

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Preoperative Assessment of the Variation in Supine to Standing Pelvic Tilt Using CT and Standing Lateral Imaging

Abstract ID: Poster 075

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INTRODUCTION: Proper component alignment is required for total hip stability and impingement free range of motion (ROM). Pelvic tilt can change when moving from a supine to standing position. The change if undetected or unaccounted for, may adversely affect postoperative functional ROM and/or standing acetabular position. This study was undertaken to determine the change in patient's preoperative pelvic tilt when moving from a supine to standing position using Computed Tomography (CT) and standing lateral radiographs.

METHODS: A consecutive series of 165 osteoarthritic patients underwent supine preoperative CT in preparation for surgery. In addition, preoperative standing lateral radiographs were obtained.

Anterior Pelvic Plane (defined as two anterior superior iliac spines and the pubic tubercle) was measured relative to the Coronal Plane for CTs and radiographs. Pelvic tilt was the angle between the Anterior Pelvic Plane and the Coronal Plane.

RESULTS: Moving from supine to standing, the pelvis flexed posteriorly in 58.8% cases (97/165, maximum 22°), with 13.9% cases (23/165) >1°. Anterior flexion occurred in 35.2% cases (58/165, maximum 22°), with 9.7% cases (16/165) >10°. There was no pelvic tilt change in 6.0% cases (10/165). Overall, 23.6% of the patients had a change in pelvic tilt) >10°.

DISCUSSION AND CONCLUSION: This is the first study showing the full pelvic tilt distribution versus frequency of occurrence using preop CT and lateral standing radiograph data. These data varied significantly from past studies using similar imaging: Uemura, more posterior tilt (18.7%, 79/422) and no cases > 10° anterior; Pierrepont, similar posteriorly tilt 6% > 13°, but 11% anteriorly > 13°. Overall, the data can be used intraoperatively to maximize functional ROM.

Creating Value with Tranexamic Acid in Total Hip Arthroplasty: How This Decision Can Safeguard Against Expensive Perioperative Costs

Abstract ID: Poster 076

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INTRODUCTION: Tranexamic acid (TXA) is effective in reducing blood loss and transfusion rate after total hip arthroplasty (THA). Patients undergoing a transfusion have higher perioperative costs and are less likely to be discharged home after THA. Allogenic blood transfusions have been shown to increase the rate of surgical site infections, non-surgical site infections, venous thromboembolism, and mortality. In this study, we build a decision model that captures the cost-saving value of intravenous (IV), topical and oral TXA during THA.

METHODS: An expected value-decision tree was constructed to estimate perioperative costs with each TXA strategy. Values for critical parameters such transfusion rate with each TXA strategy, adverse events after transfusion, and change in discharge disposition after transfusion were derived from the literature. Perioperative costs were estimated from Center for Medicare & Medicaid database of patients undergoing THA. Rollback analysis and Monte Carlo simulation consisting of 100,000 trials were performed to find the most cost-effective strategy.

RESULTS: IV and topical TXA were the most cost-effective solution with an average cost saving of over \$300 per THA. Oral TXA was also cost-effective with average cost saving of \$250 per THA. Sensitivity analysis showed that transfusion rate with no TXA and change in discharge disposition were the most sensitive parameters influencing the cost saving of each decision. Strategy tables showed how changing two parameters simultaneously changes the most cost-effective decision.

DISCUSSION AND CONCLUSION: IV and topical TXA create the most value by safeguarding against expensive perioperative costs associated with transfusions. There are limited studies using oral TXA in THA. The sensitivity analysis shows that if the transfusion rate with oral TXA is equal to the transfusion rate with IV or topical TXA, then oral TXA becomes the most cost-effective strategy. Universal adoption of TXA produces cost-savings of \$100 million annually in the United States.

Assessing the Weight-Bearing Surface in Dysplastic Acetabulae: The Sourcil Index

Abstract ID: Poster 077

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INTRODUCTION: Widespread screening and early intervention has led to successful treatment of a large proportion of patients with severe acetabular dysplasia. In spite of this, residual dysplasia remains a major cause of end stage coxarthrosis. Though a variety of standardized measurements and indices have been described to evaluate the depth, coverage, and obliquity of the acetabulum, no single measurement is without limitations. In this paper, we describe the Sourcil Index (SI), a novel measure of the weight bearing surface of the acetabulum. The SI is the angle formed by the medial and lateral margins of the sourcil and the center of rotation of the femoral head.

METHODS: All AP pelvis radiographs of skeletally mature patients obtained between 01/01/2015 and 12/31/2015 at a single institution were identified (435 patients, 870 hips). Studies with inadequate visualization, those demonstrating pelvic, acetabular or proximal femoral fractures or with implanted hardware were excluded. The remaining studies were independently evaluated by 2 orthopedic surgeons and a radiologist. The SI, Sharps Angle (SA), and Lateral Center Edge Angle (LCEA) were recorded+ by each provider 3 times, 8 weeks apart without access to previously recorded data. Measures were validated using inter-class coefficients. Cicchetti guidelines were used to interpret the ICC with values below 0.40 deemed poor, 0.4-0.59 fair, 0.6-74 good and 0.75-1.0 excellent. The SI was then compared to the SA and LCEA to determine the consistency with which it identified dysplastic acetabulae.

RESULTS: After exclusion, 535 hips in 292 patients were studied. Mean intra-observer reliability of the SI (ICC = 0.95), LCEA (ICC = 0.89), and SA (ICC = 0.90) were excellent. Inter-observer reliability for the SI (ICC = 0.90) and SA (ICC = 0.78) were excellent while LCEA (ICC = 0.73) was good. There were 51 dysplastic hips defined by both LCEA and SA. The sensitivity of the SI was 98%, specificity was 91%.

CONCLUSION: The sourcil index is a reproducible measurement on plain radiographs of the skeletally mature hip. When compared to the SA and LCEA which are accepted measures for dysplasia, the SI has excellent sensitivity and specificity.

Use of Supplemental Screw/Plate Fixation to Salvage Bone-Cement Interface Stability of a Prostalac Hip Spacer and Avoid Girdlestone Hip Resection in Patients with Severe Acetabular Bone Loss and Infection

Abstract ID: Poster 078

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BACKGROUND: Severe acetabular bone loss in the setting of hip infection may preclude the use of an articulating antibiotic spacer due to instability. Two stage re-implantation total hip arthroplasty (THA) after Girdlestone hip resection requires complex dissection to regain limb length and obtain adequate exposure, and the resulting THA has been shown to have unacceptably high rates of dislocation of 25%. We describe a versatile technique to avoid Girdlestone hip resection in the setting of severe acetabular bone loss utilizing supplemental screw/plate fixation to augment bone cement interface stability of a Prostalac articulating hip spacer.

METHODS: A retrospective review was performed from 3/2014 to 3/2017 to identify hip resection procedures performed by two fellowship-trained arthroplasty surgeons at an academic tertiary referral center. Chart review of CPT codes, operative reports, and radiographs were utilized to identify infected hip cases which were amenable to articulating spacers, and those which required Girdlestone hip resection due to acetabular bone loss and instability of a hemiarthroplasty antibiotic spacer or an articulating Prostalac spacer.

RESULTS: We identified 74 hip resection procedures performed in 61 patients (34 male, 27 female) during the study period. Girdlestone hip resection was necessary in 2 cases secondary to acetabular discontinuity. An antibiotic articulating hip spacer was utilized in the remaining 72 (97.3%) of cases. After review of these cases, insufficient intraoperative stability at the bone cement interface required supplemental fixation with an intra-articular screw through the Prostalac polyethylene in 2 cases (Average BMI 28.1), and posterior column/wall plate and screws were utilized in 3 cases (Average BMI 54.8). Complete loss of the posterior wall was identified in all cases, with medial wall bone loss/protrusion in 4/5 cases, and insufficient superior bone coverage in 4/5 cases. Prostalac articulating spacers remained in situ without instability for an average of 2.9 months prior to re-implantation THA. At re-implantation, 2 hips required a custom acetabular triflange device, while 3 hips were re-implanted with porous hemispherical acetabular components and trabecular metal augmentation.

CONCLUSIONS: Utilization of an articulating antibiotic hip spacer as opposed to Girdlestone hip resection maintains leg length, reduces surgical time and dissection at re-implantation, and decreases perioperative morbidity for the patient. In a setting of severe acetabular bone loss, utilizing screw and/or plate augmentation to salvage a Prostalac articulating hip spacer is a safe and versatile technique which should be in the armamentarium of the revision hip surgeon.

Undersizing a Modern Taper Wedge Stem Increases Subsidence and Risk of Aseptic Loosening: Surgical Technique Matters!

Abstract ID: Poster 079

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BACKGROUND: Regardless of cementless femoral component design, adequate interference fit and mechanical stability through optimal surgical technique are essential to prevent subsidence and loosening in total hip arthroplasty (THA). The purpose of this study was to determine the effect of surgical technique on radiographic subsidence and subsequent stability of a modern taper-wedge cementless stem.

METHODS: A retrospective review of 250 consecutive cementless primary THAs performed by two surgeons was performed. Surgeon A vigorously broached, maximizing the mediolateral stem dimension to the cortical bone and confirmed final broach rotational stability with a torsional test; whereas Surgeon B did not. All patients received identical tapered-wedge stems. Preoperative bone morphology was radiographically assessed by the canal-flare index. Subsidence and canal fill of femoral implants were measured on postoperative radiographs. Statistical analysis was performed to assess differences between surgical techniques with $p < 0.05$ as significant.

RESULTS: Age, height, weight, and radiographic canal flare index were statistically similar between groups. There was significantly less stem subsidence at 4 weeks with Surgeon A (0.5 mm) compared to Surgeon B (1.6 mm) ($p=0.002$). Additional subsidence at 1 year occurred in only 0.8% of Surgeon A stems (1/122) compared to 37.9% of Surgeon B implants (25/66) ($p<0.0001$). Surgeon A average radiographic canal fill was greater compared to Surgeon B ($p=0.009$). There were no aseptic loosening failures in the Surgeon A cohort. Two femoral component aseptic loosening failures (2%) occurred at average 2.5 years postoperatively in the Surgeon B group.

CONCLUSIONS: These observations support that maximizing mediolateral canal fill and avoiding under-sizing the femoral implant with a meticulous broaching technique minimizes subsidence and optimizes stability of a modern cementless taper wedge stem. Failure to optimize canal fill with appropriate broaching and surgical technique may predispose femoral components to failure from aseptic loosening.

Can the Use of a Spirit Level Improve Acetabular Component Positioning in Total Hip Arthroplasty?

Abstract ID: Poster 080

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INTRODUCTION: Accurate placement of the acetabular component is essential in primary total hip arthroplasty (THA). The purpose of this study is to determine if an analog spirit level can improve the surgeon's ability to achieve acetabular inclination within the safe-zone of 30 degrees to 50 degrees.

METHODS: We reviewed 167 primary THAs performed by a single surgeon over 14 months. Procedures were performed at two facilities, an inpatient hospital where a spirit level was utilized to aid in cup positioning and an ambulatory facility where the spirit level could not be sterilized. We excluded 47 patients with a BMI>40, age>68 or a surgical indication other than osteoarthritis who would not be considered candidates for the ambulatory center. Cup inclination angles were measured from de-identified plain radiographs by two blinded investigators who were not involved in the index procedures. The effect of level usage on inclination angle was determined using multivariate regression analysis.

RESULTS: The mean inclination angle for the 68 hips performed with the level was 42.9 degrees (95% CI: 41.7-44.0) compared to 46.5 degrees (95% CI: 45.2-47.7) for the 52 hips without it ($p<.001$). 21% of hips in the freehand group (11/52) and 13% in the spirit level group (9/68) had an abduction angle that was $< 30^\circ$ or $> 50^\circ$ ($p=.034$). Regression analysis demonstrated a 9.1% difference in cup inclination due to the level ($p<.001$), and THAs performed without the level were 3 times more likely to result in inclinations $> 50^\circ$ (OR 2.8, $p=.036$). The two investigators measurements demonstrated a correlation of 0.95 (95% CI: 0.93-0.97).

CONCLUSION: Use of a simple spirit level resulted in a significant reduction in the number of outliers compared to the freehand technique. The routine use of a spirit level may be a simple and inexpensive method to improve acetabular component abduction angles.

Inpatient vs. Outpatient Arthroplasty: A Single-Surgeon, Matched-Cohort Analysis of 90-Day Complications

Abstract ID: Poster 081

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INTRODUCTION: While some prior work supports the safety of same-day arthroplasty performed in a hospital, concerns remain when these procedures are performed in free standing ambulatory surgery centers. The purpose of this study was to compare the 90-day complication rates across matched cohorts that underwent inpatient compared to outpatient total joint replacement performed at an ambulatory surgery center.

METHODS: A single-surgeon cohort of 243 consecutive patients who underwent outpatient arthroplasty was matched with 243 inpatients that had the same procedure. One-to-one nearest-neighbor matching with respect to gender, age, ASA, and BMI was utilized. The 486 primary arthroplasties included 178 UKAs (36.6%), 146 THAs (30.0%), 92 TKAs (18.9%), and 70 hip resurfacings (14.4%). Ninety-day outcomes including reoperation, readmission, unplanned clinic or emergency department (ED) visits, major complications (including death, myocardial infarction, stroke, thromboembolic events, peripheral nerve injury, fracture, perioperative anesthesia-related complications, and surgical site infection), and minor complications (including urinary tract infection, pneumonia, and wound issues) were compared using a two sample proportions test.

RESULTS: The two cohorts were similar in distribution of demographic variables, demonstrating successful matching. Both the inpatient and outpatient cohorts had a readmission rate of 2.06% ($p=1.0$). With the number of subjects studied there were no statistically significant differences in rates of reoperations (0.4% vs. 1.65%, $p=0.18$), ED visits (1.65% vs. 2.47%, $p=0.52$), unplanned clinic visits (3.3% vs. 5.8%, $p=0.19$), major complications (5.76% vs. 5.35%, $p=0.84$), or minor complications (3.7% vs. 5.8%, $p=0.15$). Inpatients did have a higher rate of superficial surgical site infection (2.9% vs. 0.4%, $p=0.032$), and outpatients demonstrated a trend towards a higher rate of aseptic reoperations (0% vs. 1.2%, $p=0.082$).

CONCLUSION: This study suggests that arthroplasty procedures can be performed safely in an ambulatory surgery center amongst appropriately selected patients without an increased risk of complications.

SHOULDER

Risk Factors for and Timing of Adverse Events After Revision Total Shoulder Arthroplasty

Abstract ID: Poster 082

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INTRODUCTION: Despite increasing rates of revision total shoulder arthroplasty (RTSA), there is a paucity of literature on optimizing perioperative outcomes. The purposes of this study were to (1) identify risk factors for unplanned readmission and perioperative complications following RTSA, (2) risk-stratify RTSA patients based on these risk factors, and (3) assess timing of complications following RTSA.

METHODS: We used the ACS-NSQIP database to identify patients who underwent a RTSA from 2011-2015. Bivariate and multivariate analyses of risk factors for perioperative complications or readmission were assessed. Patients were risk-stratified and timing of severe adverse events and cause of readmission were evaluated.

RESULTS: We identified 809 RTSA patients, of which, 61 (7.5%) suffered a perioperative complication or readmission within 30 days of discharge. Leading causes for 30-day complications (total 46) included unplanned return to the operating room (41%), organ/space infection (13%), and deep wound infection (12%). The most common etiologies for unplanned readmission were deep wound infection (13%) and infectious disease acquired in-hospital (7%) with 13 cases (21%) of unknown etiology. Multivariate analysis controlling for patient characteristics and comorbidities identified operative time (OR 1.01), BMI>40 (OR 2.74), infection etiology (OR 2.76), high WBC count (OR 3.58), and low hematocrit (OR 5.24) as significant independent risk factors for 30-day complications or unplanned readmission after RTSA ($p \leq 0.05$). Having at least 1 significant risk factor was associated with 2.71 times risk of complication or unplanned readmission within 15 days as compared to having no risk factors (7.4% vs. 3.0% event rate, $p < 0.001$). The majority of unplanned readmission (58%), return to the operating room (67%), open/deep wound infection (53%), and sepsis/septic shock (83%) occurred within two weeks of RTSA.

CONCLUSIONS: Patients at high risk of complications and readmission after RTSA should be identified and optimized preoperatively to improve outcomes and lower costs.

Outcomes in Revision Reverse Shoulder Arthroplasty for a Failed Primary Reverse Prosthesis

Abstract ID: Poster 083

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INTRODUCTION: Patients who present with a failed reverse shoulder arthroplasty (RSA) have limited salvage options. There remains little known about outcomes in treating this problem, particularly when revising to another RSA. The purpose of this study was to examine all revision reverse shoulder arthroplasties performed for a failed reverse shoulder arthroplasty.

METHODS: We reviewed all revision RSAs performed for a failed prior RSA at our institution between 2006-2012, excluding patients with < 2 years of clinical follow-up. Overall, 27 patients were included in our study, with average age at the time of revision surgery of 70 years (range, 58-82). Comorbidities included smoking (n=3), diabetes mellitus (n=3), and rheumatoid arthritis (n=2).

RESULTS: At a mean follow-up of 4.4 years (range, 2-10), 6 shoulders (22%) developed postoperative complications requiring revision surgery at mean 1.7 years postoperatively. The etiologies for revision surgery were dislocation (n=2), glenoid loosening (n=1), humeral component fracture (n=1), glenosphere dissociation (n=1), and infection (n=1). The 5-year revision-free survival rate was 85%. There were five complications not requiring revision surgery, namely dislocation (n=3) and periprosthetic fracture (n=2), with no neurologic injuries or additional prosthetic infections noted. Overall, patients experienced excellent pain relief and improvements in shoulder abduction and external rotation ($p < 0.01$). The average postoperative ASES and simple shoulder test (SST) score were 66 and 7, respectively. At last radiographic follow-up, 6 patients (23%) had glenoid lucency, with 3 (12%) classified as grade III or higher. Smokers demonstrated an increased the risk of glenoid loosening ($HR > 10$, $p < 0.01$).

CONCLUSIONS: Revision reverse shoulder arthroplasty, when used to revise a prior failed reverse prosthesis, is a successful procedure. At an intermediate follow-up period, there are reasonable implant survival rates, but postoperative periprosthetic instability and glenoid loosening is a concern, particularly in smokers. Regardless, RSA provides a reasonable option in the revision setting to relieve pain and improve shoulder function.

High Rate of Preoperative Opioid Use Among Shoulder Arthroplasty Patients Predicts Prolonged Postoperative Opioid Use

Abstract ID: Poster 084

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INTRODUCTION: Preoperative opioid use has been linked to worse postoperative outcomes, and is representative of the growing opioid epidemic. The purpose of this study is to determine the incidence of preoperative opioid use in patients undergoing shoulder arthroplasty, analyze the effect of preoperative opioid use on prolonged postoperative use, and determine if the incidence of opioid use significantly changes past 1 year postoperatively.

METHODS: A retrospective shoulder registry query was performed for patients undergoing anatomic or reverse total shoulder arthroplasty or hemiarthroplasty since 2007. Patients were asked, 'Do you take narcotic pain medication (codeine or stronger)?' at preoperative and postoperative appointments. The percent of patients using opioids at 1 year and most recent follow-up appointments were compared based upon preoperative opioid use.

RESULTS: Among the 707 patients with a minimum 1-year follow-up, 34.1% reported preoperative opioid use and 17.1% reported opioid use at final follow-up (mean 37 months, range 12-124). Patients reporting preoperative narcotic use had a significantly higher incidence of postoperative opioid use at 1 year (32.2% vs. 4.4%, $p<0.001$) and final follow-up (37.3% vs. 6.7%, $p<0.001$). Among the 490 patients with a minimum of 2-year follow-up, 35.5% reported preoperative opioid use and 17.1% reported opioid use at most-recent follow-up (mean 47 months, range 24-124). Patients reporting preoperative narcotic use had a significantly higher incidence of opioid use at 1-year (29.1% vs. 4.9%, $p<0.001$) and at final follow-up (35.1% vs. 7.3%, $p<0.001$). The incidence of opioid usage did not change significantly between 1-year and final follow-up visits for patients with ($p=0.171$ at minimum 1 year; $p=0.366$ at minimum 2-year) or without ($p=0.210$ at minimum 1-year; $p=0.163$ at minimum 2-year) preoperative opioid use.

CONCLUSIONS: Over 1/3 of the patients in this study were taking preoperative opioids. The cohort of patients taking preoperative opioids had a 5-fold greater rate of opioid use postoperatively. Furthermore, opioid usage did not significantly change from 1-year follow-up to final follow-up, suggesting that patients who remain on opioid medications at their 1-year postoperative appointment will likely continue to utilize opioids.

Five-Year Minimum Clinical and Radiographic Outcomes of Total Shoulder Arthroplasty Utilizing a Hybrid Glenoid Component with a Central Porous Titanium Post

Abstract ID: Poster 085

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INTRODUCTION: Glenoid component loosening remains one of the most common complications in total shoulder arthroplasty (TSA). Hybrid glenoid components that supplement traditional cemented fixation with ingrowth technology have been introduced in hopes of mitigating this complication. However, initial reports of ingrowth glenoids have not been consistently promising. We proposed to evaluate the minimum five-year clinical and radiographic outcomes of TSA utilizing a hybrid glenoid component employing a central porous titanium post.

METHODS: Thirty-nine shoulders undergoing TSA for primary glenohumeral osteoarthritis with a minimum of 5 years of follow-up composed the study group. Patients were evaluated pre- and postoperatively with American Shoulder and Elbow Society (ASES) scores, visual analog scale (VAS), and active shoulder range of motion. Postoperative films at a minimum of 5 years follow-up were analyzed for radiolucent lines by zones, progressive loosening, or at-risk signs. Paired t-tests were used to determine statistical differences ($p < 0.05$) in preoperative vs. postoperative outcomes.

RESULTS: Thirty-nine TSAs with a mean patient age of 64.4 years (range 51-93) and an average follow-up of 67.2 months (range 60-84 months) comprised the study group. The average ASES score improved from 41.4 to 85.6 ($p < 0.0001$). VAS scores improved from 5.7 to 0.7 ($p < 0.0001$). Forward elevation (112° to 153° , $p < 0.001$), internal rotation (36° to 50.5° , $p = 0.0014$), and external rotation (46° to 59.3° , $p = 0.01$) all demonstrated significant improvement as well.

Radiographic evaluation demonstrated that 14 implants (36%) had no evidence of glenoid component radiolucency, 4 (10%) had evidence of radiolucencies confined to the area under the glenoid faceplate (Zones 1 and/or 5), and 12 (31%) showed partial radiolucencies around the central ingrowth post. Eight TSAs (21%) demonstrated two or more zones of involvement but were not judged to be at-risk. One implant (3%) had glenoid component failure, but the patient declined further intervention. Overall, there were no revisions for loosening or mechanical failure.

CONCLUSION: These results demonstrate statistically significant improvements in clinical outcomes at a minimum of five years utilizing a hybrid glenoid component with a central porous titanium ingrowth post. Radiographic evaluation demonstrated periprosthetic glenoid lucencies comparable to other reported series and one case of mechanical failure. No cases required revision surgery. Overall, this hybrid component shows favorable intermediate-term radiographic results. Further evaluations will be needed to demonstrate the long-term durability of these

implants and to determine the significance and fate of the radiolucent lines, particularly relative to the central post.

Reverse Total Shoulder Arthroplasty for Proximal Humerus Nonunion: The Effect of Prior Internal Fixation

Abstract ID: Poster 086

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BACKGROUND: Proximal humerus nonunion with glenohumeral cartilage damage after fracture can be detrimental to upper extremity function. Surgical reconstructive options include internal fixation and arthroplasty, but both are associated tuberosity problems their functional sequelae. The implant design of a reverse total shoulder arthroplasty (RSA) may be able to compensate for this problem. Some studies, however, have reported a high dislocation rate, especially when the tuberosity is absent or excised. Additionally, the outcome may be different for patients with and without prior surgery. The purpose of this study was to evaluate the outcome of RSA for proximal humerus nonunion, with and without prior internal fixation.

METHODS: Between January 2004 and April 2015, 30 consecutive RSAs were performed at our institution for proximal humerus nonunion. Eleven shoulders had 1+ previous surgeries, whereas 19 shoulders had no prior surgery. A retrospective chart review was performed to determine pain, range of motion, and complications. The average follow-up time was 40 months (range, 24-75).

RESULTS: In the non-operative group, there was 1 male and 18 females. The time between the index fracture and RSA was 1.2 years (5 months-5.6 years). Pain scores decreased from moderate-severe (89%) prior to surgery to none-mild (80%) at most recent follow-up. Average elevation improved from 35° to 106° ($p<0.05$), external rotation from 15° to 28°, and internal rotation to one level higher. Implants used included standard implants (12), tumor-like prosthesis (4), and allograft-prosthetic composite (4). Complications included deep infection (1) and traumatic periprosthetic fractures (2).

The internal fixation group consisted of two males and 9 females with an average of 1.9 (range, 1-5) prior procedures. The time between index fracture and RSA was 0.8 years (2 months-1.7 years). Three shoulders had a history of previous infection. Pain scores decreased from moderate-severe (100%) preoperatively to mild-moderate (73%) at follow-up. Average elevation improved from 41° to 87° ($p<0.05$), external rotation from 14° to 40°, and internal rotation to one level higher ($p<0.05$). Implants used included standard implants (10) and allograft-prosthetic component (1). Complications included humeral loosening (2) and dislocations (2).

CONCLUSION: RSA provides satisfactory outcomes with improved pain and arm elevation in the management of proximal humerus nonunions. There was an increased complication rate for nonunions with previous surgery and an increased use of augmented prosthesis in nonunions without previous surgery.

Revision Reverse Shoulder Arthroplasty for Prosthetic Instability

Abstract ID: Poster 087

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INTRODUCTION: Instability following shoulder arthroplasty remains a complication with limited salvage options. The purpose of this study was to evaluate the outcomes of revision shoulder arthroplasty to a reverse prosthesis (RSA) for the indication of prosthetic instability, including complications, need for further surgery, and estimated survivorship free of recurrent instability.

METHODS: All shoulder arthroplasties revised for prosthetic instability using RSA components between January 2004 and July 2014 were retrospectively reviewed. Sixty-five patients with minimum 2-year follow up were included (mean follow-up 3.2 years, range 2-10 years). The mean age at the time of revision RSA was 65 (40 – 89) years.

RESULTS: Ten (15%) shoulders suffered additional episodes of prosthetic dislocation and six (9%) shoulders underwent reoperation or revision for dislocation. The survivorship-free of dislocation at 2 and 5 years was 87% and 79%, respectively. The implant survival-free of revision or reoperation for dislocation at 2 and 5 years was 94% and 86%, respectively. Persistent instability was more common in those with a BMI over 35 kg/m² (HR 4.71, p=0.008) and prior hemiarthroplasty (HR, 5.43, p=0.005). Patients undergoing revision RSA for instability experienced significant improvements in their preoperative to postoperative pain levels (p<0.001) and shoulder elevation and external rotation (p<0.001). American Shoulder and Elbow Society scores (ASES) improved from 21 preoperative to 68 postoperative (p<0.001). The Simple Shoulder Test (SST) scores improved from 2 preoperative to 5 postoperative (p<0.001).

CONCLUSION: Revision RSA for prosthetic instability following shoulder arthroplasty is associated with reasonable implant survival. Given the complexity of these cases, it is a reasonable option. Approximately 1 in 7 will have a recurrent dislocation, while 1 in 10 will require a repeat intervention for this dislocation. If the implant remains dislocation-free, patients experience excellent pain relief and improvements in their shoulder pain and function.

Intra- and Interobserver Reliability of the Modified Walch Classification Using Radiographs and Computed Tomography Scans

Abstract ID: Poster 088

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INTRODUCTION: The Walch classification has traditionally been used to classify glenoid morphology in primary glenohumeral osteoarthritis. Several studies have reported the interobserver and intraobserver reliability of the classification. Reliability reports by authors other than the creator of the classification have shown inter-rater reliabilities between fair and moderate, and intra-rater reliability being substantial. The modified Walch Classification was recently proposed, which added two additional categories for a more precise definition of the previously A2 glenoid. Other than having been reported in the original publication describing this modification, the reliabilities have not been studied as of yet. The purpose of this study was to evaluate the intra- and interobserver agreement of the modified Walch classification system using x-ray and CT.

METHODS: Three fellowship-trained shoulder surgeons blindly and independently evaluated the radiographs and CT scans of 100 consecutive shoulders (98 patients) with primary glenohumeral osteoarthritis. Each observer classified all shoulders according to the modified Walch classification in four separate sessions, each four weeks apart. Statistical analysis using Kappa coefficient was used to evaluate reliability.

RESULTS: The first reading by the most senior observer based on CT scans was arbitrarily used as the gold standard. This revealed the following distribution: A1 18, A2 12, B1 20, B2 25, B3 22, C 1, D 2. The average intraobserver agreement for radiographs was 0.73 (substantial; 0.72, 0.74, 0.72). The average intraobserver agreement for CT scans was 0.73 (substantial; 0.77, 0.69, 0.72). Additionally, pairwise comparisons between observers occurred, with the average interobserver agreement for radiographs was 0.55 (moderate; 0.61, 0.51, 0.53). The average interobserver agreement for CT was 0.52 (moderate; 0.63, 0.50, 0.43).

CONCLUSION: In this study, intraobserver agreement for the modified Walch classification based on axillary radiographs and CT scans were both substantial. Interobserver agreement, however, was fair based on the same images. These findings are consistent with those of reliability studies that were performed using the original classification. Our results were also similar to those observed by the authors of the modified classification, who observed an interobserver reliability that was substantial (.703) and a nearly perfect agreement of intraobserver reliability (0.882). In this study though, intraobserver agreement using radiographs was substantial, the interobserver agreement was superior with the use of CT. These findings are consistent with prior work done at our institution, and support the use of CT rather than axillary radiographs for the evaluation of glenoid morphology when preparing for shoulder arthroplasty.

Key Words: Glenoid Retroversion, Glenohumeral Osteoarthritis, Shoulder arthroplasty

Do Medicaid Patients Do as Well After Rotator Cuff Repairs?

Abstract ID: Poster 089

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INTRODUCTION: In 2016, Medicaid is the single largest health insurance program in the United States, covering more than 60 million patients. Medicaid insurance as a primary payer have been shown to negatively impact resource utilization and risk-adjusted outcomes for total joint arthroplasty; however, little is known about rotator cuff repairs. The purpose of this study was to assess the effects of Medicaid primary payer status on outcomes following arthroscopic rotator cuff repair (RCR).

METHODS: A retrospective review of 174 shoulder surgery patients treated by a single surgeon was undertaken to identify 61 patients who underwent RCR. Patients were stratified based on insurance type into two cohorts: 31 Medicaid patients and 30 non-Medicaid patients. 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).

RESULTS: The cohorts were well matched with no statistically significant differences in demographics, comorbidities, or preoperative baseline scores, with the exception of age. Medicaid patients missed a greater percentage of postoperative follow-up visits (22%) compared to non-Medicaid patients (14%), this difference was not significant ($p = 0.190$). Medicaid and non-Medicaid patients experienced significant improvement on all patient-reported outcomes; however, non-Medicaid patients demonstrated significantly higher absolute postoperative scores for ASES ($P = 0.033$), PSS ($P = 0.034$), and SSV ($P = 0.032$) measures after RCR.

CONCLUSION: Overall results suggest that Medicaid patients can expect significant improvement in patient-reported outcomes and function after RCR. Surgeons should counsel Medicaid patients; however, that they may not expect the same level of patient reported satisfaction or outcomes as those patients with primary insurance other than Medicaid after RCR.

Reverse Shoulder Arthroplasty for Proximal Humerus Malunion: The Effect of Previous Internal Fixation

Abstract ID: Poster 090

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BACKGROUND: Proximal humerus malunion can be detrimental to upper extremity function. Surgical options for reconstruction, including hemiarthroplasty and anatomic total shoulder arthroplasty, have been associated with a substantial rate of failure. Reverse total shoulder arthroplasty (RSA) is another treatment option and may compensate for poor cuff function. However, RSA outcomes may vary depending on whether initial treatment was operative with internal fixation or nonoperative. The purpose of this study was to evaluate the outcomes of RTSA for proximal humerus malunion previously treated with and without surgical intervention.

METHODS: Between January 2004 and April 2015, 46 consecutive RSA were performed in our institution for a proximal humerus malunion. Previous internal fixation was conducted in 24 shoulders, whereas 22 shoulders had no previous surgery. A retrospective chart review was performed to determine pain, range of motion, and complications. Radiographs were reviewed to evaluate implant fixation and notching. The average follow-up time was 42 (range, 24-71) months.

RESULTS: In the non-operative group, there were 7 males and 17 females. The time between index fracture and RSA was 7.9 years (2 months-4 years). Pain scores decreased from moderate (13) - severe (10) preoperatively to none (15) - mild (9) at follow-up. Average active elevation improved from 69° to 127°, active external rotation from 13° to 40°, and active internal rotation to one level higher. Implants used included standard implants (22), allograft-prosthetic composite (1), and a tumor-like implant (SRS) (1). Complications included deep infection (1), stress fracture of the acromion (1), dislocation (1), and traumatic periprosthetic fracture (1).

In the internal fixation group, there was 1 male and 21 females with an average of 1.5 (range, 1-4) prior procedures. The time between the index fracture and RSA was 2.2 years (5 months-10.8 years). Four shoulders had a prior infection. Pain scores decreased from moderate (8) - severe (13) preoperatively to none (10) - mild (8) at most recent follow-up. Average active elevation improved from 48° to 121°, active external rotation from 1° to 39°, and active internal rotation to one level higher. Implants used included standard (19), tumor-like prosthesis (1), and strut allograft augmentation (1). One shoulder sustained an intraoperative humerus fracture proximal to the stem that healed uneventfully.

CONCLUSION: RSA results in satisfactory outcomes for the management of proximal humerus malunion. In this study, no difference in outcomes were observed when patients with and without prior internal fixation attempts were compared. The complication rate was higher in shoulders with no prior surgery.

Change in the Glenoid Inclination Does Not Affect Patient Reported Outcomes After Lateralized Reverse Shoulder Arthroplasty

Abstract ID: Poster 092

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INTRODUCTION: Proper glenoid component position plays an important role in the biomechanics and longevity of reverse shoulder arthroplasty (RSA). Specifically, glenosphere inclination has been studied in relation to scapular notching, loosening, and stability. However, there has been no study evaluating the effect of glenoid inclination change after lateralized RSA on patient reported outcomes.

GOAL: We sought to determine to what degree surgeons change glenoid inclination after RSA implantation and if that absolute change is an independent predictor of patient reported outcomes.

MATERIAL AND METHODS: Two fellowship-trained orthopedic surgeons retrospectively reviewed pre- and postoperative radiographs of 82 patients who underwent lateralized RSA due to cuff tear arthropathy. The mean age of the cohort was 68.9 +/- 7.5 years. Fifty patients were female and 32 were male. The inclination β -angle, as described by Maurer et al., was measured pre- and postoperatively in each patient by 2 independent orthopedic surgeons. The inter-rater reliability was 0.90. Patient reported outcomes were assessed via the American Shoulder and Elbow Surgery (ASES) score at the last follow-up visit; the mean follow-up was 42.5 months for outcomes (range, 24-104 months).

RESULTS: Six patients underwent an increase in inclination (average increase 3.6 +/- 2.6 degrees) (P=0.40). The remaining patients underwent a mean decrease in inclination of 11 +/- 6.1 degrees (P<0.0001). Four categories of inclination change were established based upon the direction and mean change value: low decrease (0-5 degrees) – 10 patients, decreased (5-17 degrees) – 54 patients, high decreased (> 17 degrees) – 12 patients, and increased (6 patients). There was no significant differences in the ASES scores between the groups (P=0.19). The overall ASES score was 70 (+/-22.6) at final follow-up.

CONCLUSION: This is the first study to assess the influence of change in inclination on patient reported outcomes after RSA. Glenoid inclination is changed after RSA to variable degrees, including some cases of increased inclination. In spite of the biomechanical and theoretical recommendations to inferiorly tilt the glenosphere 10 degrees, we found that changing inclination did not affect complication rates or outcomes in a lateralized RSA design at short to intermediate term follow-up. Longer term follow-up is warranted to determine if these results remain stable over time.

Is Preoperative Glenoid Type Predictive of Patient-Reported Outcomes After Anatomic Total Shoulder Arthroplasty?

Abstract ID: Poster 093

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INTRODUCTION: Preoperative glenoid morphology has been suggested as a significant risk factor in outcomes after anatomic total shoulder arthroplasty (TSA). Glenoids with significant retroversion or humeral head subluxation have been recently recommended to undergo reverse shoulder arthroplasty (RSA) as a primary procedure. Evidence regarding the influence of preoperative glenoid morphology on postoperative patient reported outcomes is scant. The purpose of this study, therefore, was to determine if glenoid morphology, as classified by Walch type, was predictive of patient outcomes after anatomic TSA.

METHODS: A retrospective chart review of prospectively collected data was performed on all patients who had undergone an RSA with minimum 2 years follow-up (FU) and preoperative MRIs. Preoperative glenoid morphology was classified based on the Walch system. Additionally, each patient was surveyed with the American Shoulder and Elbow (ASES) score at the last FU. Overall, 56 patients with average age of 65.2 years (SD 10.6) were eligible for further analysis. There were 35 female and 21 male patients in the studied cohort. In addition, we performed a sub-analysis for patients under 65 years of age on the day of surgery. We found 27 patients with an average age of 56.9 years (SD 7.2).

RESULTS: The average FU for the cohort was 46 (SD 14) months. A1 glenoid was found in 8 patients, A2 in 23, B1 in 6, B2 in 14, and B3 in 5 patients. When an ANOVA test was applied, no significant differences in ASES scores were found between the groups ($P=0.92$). The average ASES score for the overall cohort was 70 (SD 25) points. When type A glenoids were compared to type B glenoids, no significant difference was found (67 vs. 73 ASES, $P=0.2$). ANOVA sub-analysis for patients under 65 years old did not reveal any differences between the glenoid types either ($P=0.59$). The average ASES score for this subgroup was 64.1 (SD 26.9).

CONCLUSION: Glenoid morphology may not affect outcomes after anatomic TSA at short-term (near 4 year) follow-up. Longer term analysis will be necessary to determine whether these results will remain stable over time. These findings suggest that anatomic TSA remains a reasonable option in patients with abnormal glenoid morphology out to four years.

Reverse Shoulder Arthroplasty in Weight-Bearing Shoulders of Wheelchair-Dependent Patients

Abstract ID: Poster 094

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BACKGROUND: Wheelchair-dependent patients rely on their upper extremities for mobility and transfers. This entails the heavy use of upper extremities as weight-bearing joints, leading to shoulder overuse with increased prevalence of rotator cuff-related disorders, and ultimately to challenging cases for shoulder surgeons. The purpose of this study was to report the outcomes of reverse shoulder arthroplasty (RSA) in wheelchair-dependent patients with arthritis and rotator cuff tears.

METHODS: Between January 2004 and December 2013, 1289 RSA procedures were performed by the senior authors. Of these, 22 patients were identified as wheelchair-dependent, and 18 of them had a minimum follow-up of 2 years. There were 9 men and 9 women, with a mean (SD) age and length of follow-up of 68 (8.5) years and 36 (24-63) months. All relevant data were extracted through a retrospective chart review. In addition, patient-reported perception about the surgical success and estimates of cumulative implant loading were obtained in a cross-sectional manner through phone calls to all non-deceased patients.

RESULTS: RSA resulted in a significant improvement in pain ($p=0.02$) and non-significant improvements in forward flexion ($p=0.3$) and external rotation ($p=0.07$). There were 3 (16%) excellent, 12 (63%) satisfactory, and 4 (21%) unsatisfactory results. The mean (SD) postoperative ASES and SST scores were 56.5 (16.5) and 4.1 (3.5), respectively. The mean (SD) subjective satisfaction was 6 of 10 (2.4). All patients stated that they would undergo RSA again. One patient had a postoperative ulnar neuropathy that required ulnar nerve decompression and transposition. There were no other surgically-related complications or reoperations. The 90-day mortality and morbidity rates were 0% and 26%, respectively. The estimated mean (range) total number of implant loading cycles counted after the first postoperative months was 254,009 (10,912-1,125,717).

CONCLUSIONS: RSA is a safe and effective procedure in wheelchair-dependent patients who use their shoulders for weight-bearing purposes. Though absolute values for functional scores are not optimal and medical complications are not uncommon, 79% of patients had an excellent or satisfactory result, there was an improvement in range of motion, and no patients had implant failure after a minimum follow-up time of 2 years.

A Quantitative Analysis of Deltoid Lengthening on Associated Complications Following Reverse Total Shoulder Arthroplasty

Abstract ID: Poster 095

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BACKGROUND: Reverse total shoulder arthroplasty (RTSA) reduces pain and improves function for a number of rotator cuff deficient conditions. Inferior glenosphere positioning and medialization of the center of rotation act to increase the deltoid lever arm to restore forward elevation. However, overtensioning of the deltoid can have negative clinical consequences, including acromion fractures, deltoid dehiscence, and prolonged pain. We proposed to compare deltoid length in a 1:2 matched cohort of patients with and without deltoid tension-related complications following RTSA.

MATERIALS AND METHODS: We retrospectively identified 13 patients who developed postoperative complications following RTSA including 9 patients with acromion fractures or deltoid dehiscence, and 4 patients with persistent (>2 years postoperative) deltoid pain. These were compared with a cohort of 26 patients (1:2 matching) without postoperative deltoid complications that were matched according to age and operative indication. Component lateralization was also standardized between groups. Minimum follow-up was 2 years for all patients. We excluded cases of revision arthroplasty or prior history of deltoid dysfunction. Average deltoid lengthening was measured radiographically from preoperative and postoperative radiographs using established techniques. One-way ANOVA with post-hoc testing was used to identify differences in deltoid length between cohorts. Nonparametric analyses (Pearson chi-square analysis, Kendall's tau coefficient) were used to examine all nominal variables for association. Differences with $p < 0.05$ were considered statistically significant.

RESULTS: The experimental cohort of 13 patients included 6 patients with acromion fractures, 3 with deltoid dehiscence, and 4 with persistent deltoid pain. The control group was composed of 26 patients without deltoid related complications. The average age for the overall cohort was 71 years and there were no significant differences between groups regarding age, sex, operative indication, the use of bone graft, or duration of follow-up. Average deltoid lengthening was found to be 21 mm. Patients with deltoid-related complications had significantly greater deltoid lengthening (acromion fracture or deltoid dehiscence 29 mm [range 17-41 mm]; persistent deltoid pain 26 mm [range 18-36 mm]) compared to those without complications (17 mm [range 5-30 mm]; $p=0.002$).

CONCLUSION: Patients with postoperative acromion fractures, deltoid dehiscence, or persistent deltoid pain had significantly greater deltoid lengthening than a control group without complications. Further, this degree of lengthening corresponds to previously published biomechanical data regarding the degree to which the deltoid can tolerate elongation. Surgeons should be cognizant that lengthening the deltoid more than 25 mm during RTSA increases the risk of postoperative tension-related complications.

KNEE

Reliable Outcomes and Survivorship of Unicompartmental Knee Arthroplasty for Isolated Compartment Osteonecrosis

Abstract ID: Poster 096

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INTRODUCTION: Primary (or spontaneous) and secondary osteonecrosis of the knee can lead to severe joint degeneration for which an arthroplasty may be considered. However, there are limited studies analyzing the outcomes of unicompartmental knee arthroplasties (UKAs) for knee osteonecrosis. The goals of this study were to analyze outcomes of UKAs for osteonecrosis with specific focus on (1) survivorship free of any revision or reoperation, (2) complications, and (3) clinical outcomes.

METHODS: Forty-five patients (46 UKAs) were completed for osteonecrosis of the knee from 2002–2014 at a single academic institution. Forty-three (93%) were medial UKAs and 11 (24%) were mobile-bearing. Mean limb mechanical axis postoperatively was 1.5 degrees varus (range, 0–5 degrees varus). Forty-one UKAs (89%) were performed for primary osteonecrosis. Mean age was 66 years and mean BMI was 31 kg/m². Mean follow-up was 5 years.

RESULTS: Survivorship free of any revision was 98%, 89%, and 76% at 2, 5, and 10 years, respectively. Survivorship free of any revision or reoperation was 95%, 88%, and 76% at 2, 5, and 10 years, respectively. Three medial UKAs (7.5%) were converted to TKAs, two for lateral compartment degeneration and one for development of lateral osteonecrosis. One UKA (2.5%) underwent irrigation, debridement, and modular exchange for an acute postoperative infection. No implants were revised for loosening or wear. Perioperative complications occurred in one patient (2.5%) whom had an in-hospital myocardial infarction. Knee Society scores improved from a mean of 60 preoperatively to a mean of 94 postoperatively ($p < 0.001$).

CONCLUSION: UKA for osteonecrosis of the knee results in improved clinical outcomes, minimal complications, and durable implant survivorship at 10 years. Progression of knee degeneration, rather than implant failure or loosening, was the most common indication for conversion to TKA. Survivorship is consistent with prior studies analyzing UKAs for unicompartmental osteoarthritis.

Opioid and Illicit Drug Use Screening in the Total Joint Population

Abstract ID: Poster 097

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INTRODUCTION: Recent studies have shown an increase in postoperative orthopedic complications with preoperative opioid use. However, these studies only used documented opioid use from the patient's history and did not evaluate for illicit drug use in patients undergoing total joint arthroplasty (TJA). This study evaluated for the prevalence of preoperative narcotic and illicit drug use in patients undergoing total knee or total hip arthroplasties by using urine drug screening (UDS) and assessed how many patients disclosed this information preoperatively.

METHODS: A retrospective analysis of 169 consecutive patients, in a community-based practice, had a preoperative UDS prior to primary or revision TJA by a single fellowship-trained orthopedic surgeon (TB). Data collected included the patient demographics, documented pre-opioid and illicit drug use, comorbid diagnosis, and UDS results.

RESULTS: The patients' average age was 65 (range; 28-86) with majority of the patients' insurance being either Medicare at 51% (86/169) or Commercial at 43% (72/169). Of this population 46% (78/169) had a positive UDS. 41% (70/169) of which had a positive UDS for preoperative opioids, with 12% (20/169) of the patients having no prior clinical history or prescription for these narcotics. 10% (17/169) of these patients in this study had a positive UDS for illicit drugs. Where 4% (7/169) of these patients had no prior clinical history or had disclosed this information to the physician.

CONCLUSION: A UDS can be used for initial risk evaluation for patients undergoing TJA, as patient documented clinical history proved to be inadequate.

Clinical Outcomes and Survivorship of Lateral Unicompartmental Knee Arthroplasty: Does Surgical Approach Matter?

Abstract ID: Poster 098

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INTRODUCTION: Lateral unicompartmental knee arthroplasty (UKA) has been shown to be an effective procedure to treat isolated lateral compartment osteoarthritis with excellent long-term survivorship. The purpose of this study was to determine if there is a difference in intermediate-term clinical outcomes in patients undergoing lateral UKA through a lateral vs. medial parapatellar approach.

METHODS: We retrospectively reviewed a consecutive series of 65 patients from 2003-2014 at a single institution who underwent lateral UKA with a minimum of 2-year follow-up. Fifty-two patients (80%) had a lateral approach and 13 (20%) a medial parapatellar approach based upon surgeon preference. Patient demographics, pre-and postoperative radiographic findings, need for revision surgery, knee society score (KSS), and range of motion were compared between the two approaches. A Kaplan-Meier survivorship analysis was performed with an endpoint of all-cause revision. A multivariate analysis was then conducted to identify independent risk factors for revision surgery and poor outcomes.

RESULTS: At a mean follow-up of 82.3 months, overall survivorship was 94%. Mean survivorship of all patients was 151.1 months (95% CI 142.5-161.9 months). There was no difference in revision rates (5% vs. 7%, $p=1.000$) or improvement in KSS (22.7 vs. 22.2 points, $p=0.977$) between the medial and lateral approach groups. The lateral approach group did achieve significantly greater postoperative flexion (123.6 vs. 116.5 degrees, $p=0.006$). When controlling for confounding variables, a lateral parapatellar approach was not a risk factor for revision surgery (OR=0.259, 95% CI 0.006-10.374, $p=0.473$) or poor outcome (OR 1.205, 95% CI 0.125-11.618, $p=0.872$).

CONCLUSIONS: LUKA provides good clinical results with a low revision rate regardless of surgical approach at intermediate term follow-up. A lateral approach did result in statistically greater postoperative flexion, but its clinical significance remains undetermined.

Incidence, Risk Factors, and Impact of Clostridium Difficile Colitis Following Primary Total Hip and Knee Arthroplasty

Abstract ID: Poster 099

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INTRODUCTION: Clostridium difficile colitis is important as it is used as a measure of hospital quality and is associated with substantial morbidity. The purpose of this study is to determine the incidence, timing, risk factors, and clinical implications of C. difficile colitis following primary total hip or knee arthroplasty (THA or TKA).

METHODS: Patients who underwent primary THA or TKA as part of the 2015 National Surgical Quality Improvement Program were reviewed for a diagnosis of C. difficile colitis within the 30-day postoperative period. Risk factors for the development of C. difficile colitis were identified using multivariate regression.

RESULTS: 39,172 Patients were identified. The incidence of C. difficile colitis was 0.10%. 79% of cases were diagnosed post-discharge, and 84% of cases had not had a preceding infection. Independent preoperative risk factors for the development of C. difficile were greater age (most notably ≥ 80 years, relative risk [RR]=5.28, $p=0.008$), dependent functional status (RR=4.05, $p=0.008$), anemia (RR=2.52, $p=0.007$), hypertension (RR=2.51, $p=0.037$), and THA (versus TKA; RR=2.25, $p=0.017$). Postoperative infectious risk factors were urinary tract infection (RR=10.66, $p<0.001$) and sepsis (RR=17.80, $p<0.001$). The development of C. difficile prior to discharge was associated with greater length of stay (2.6 versus 6.6 days; $p<0.001$) and the development of C. difficile following discharge was associated with increased 30-day readmission (RR=8.01, 95%CI = 5.03-12.77, $p<0.001$).

DISCUSSION: C. difficile colitis was diagnosed in approximately 1 in 1,000 patients undergoing primary THA or TKA. The majority of these cases occurred post-discharge and in patients not having other infection diagnoses, suggesting prophylactic antibiotics as potentially causative. High-risk patients identified in the current study should be targeted with preventative interventions. In addition, when ordering prophylactic antibiotics or managing infections such as UTIs in high-risk patients, surgeons should consider selecting an antibiotic with lower risk for predisposing patients to C. difficile colitis.

Systemic Lupus Erythematosus: A Risk Factor for Complications in Total Hip and Knee Arthroplasty

Abstract ID: Poster 100

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INTRODUCTION: Systemic Lupus Erythematosus (SLE) has been associated with increased complications following hip and knee arthroplasty. The purpose of this study was to determine the extent to which SLE is a risk factor in outcomes following total joint arthroplasty (TJA).

METHODS: The nationwide inpatient sample was used to identify a cohort of 505,841 patients who had a total hip arthroplasty (THA) or total knee arthroplasty (TKA) between 2009-2011. Of these patients, 2,284 patients (0.45%) had been previously diagnosed with SLE. The impact of SLE on 90-day postoperative TJA outcomes was determined using multivariate logistic regression. Differences in discharge destination and length of stay were also evaluated.

RESULTS: SLE patients were more likely to have an all-cause medical complication, (OR 1.7, $p<0.0001$) and more likely to have an all-cause surgical complication (OR 1.3, $p<0.0001$). SLE patients were three times more likely to become septic in the postoperative period (OR 2.9, $p<0.0001$). SLE patients were more likely to have a genitourinary complication (OR 1.6, $p<0.0001$), bleeding complications requiring transfusion (OR 1.7, $p<0.0001$), or pulmonary insufficiency following surgery (OR? pending per Yubo, $p<0.0001$). Patients with SLE also had an increased length of stay (0.28 days, $p<0.0001$) and increased probability of discharging to a facility (OR 1.2, $p<0.0001$).

CONCLUSIONS: Patients with SLE had an increased rate of both medical and surgical all-cause complications. Patients were specifically found to be at higher risk of genitourinary complications and pulmonary complications, and had elevated rates of transfusions. Future risk adjustment models should include SLE as a contributor to medical and surgical complications in the postoperative period.

SUMMARY: SLE was associated with increases in medical and surgical complications following lower extremity TJA. This risk needs to be considered in risk adjusted models.

Key Words: Total hip arthroplasty; total knee arthroplasty; systemic lupus erythematosus; nationwide inpatient sample; all-cause complications

Selective Use of Synovial Fluid Alpha-Defensin Can Guide Management in the Equivocal Diagnosis of Periprosthetic Joint Infection

Abstract ID: Poster 101

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INTRODUCTION: Synovial fluid alpha-defensin has shown to be a reliable diagnostic test for the diagnosis of periprosthetic joint infection (PJI), but its use in equivocal cases has yet to be established. The purpose of this study is to determine the reliability of alpha-defensin in patients where the diagnosis of PJI was unclear.

METHODS: We retrospectively reviewed a consecutive series of 40 synovial aspirations by a single surgeon that were sent for alpha-defensin in equivocal cases of PJI. Indications for testing included recent antibiotic use, borderline synovial fluid cell count and differential, suspected culture negative infection, and suspected false positive culture. Modified Musculoskeletal Infection Society (MSIS) criteria were used to determine if PJI was present. Accuracy, specificity, and sensitivity of alpha-defensin testing were calculated based on indication for aspiration.

RESULTS: Of the 40 aspirations, there were 34 knee (85%) and 6 hip patients (15%). Eleven patients (28%) met MSIS criteria for PJI. Of the 25 recent antibiotic usage patients (7 MSIS positive, 18 negative), alpha-defensin results confirmed the correct MSIS diagnosis in 20 patients (80%). Of the 10 patients where alpha-defensin was performed for a borderline cell count (2 MSIS positive, 8 negative), alpha-defensin confirmed the MSIS diagnosis in all 10 patients (100%). Finally, amongst the 5 patients with suspected falsely positive or negative cultures (2 MSIS positive, 3 negative), alpha-defensin confirmed the correct diagnosis in 3 patients (60%). The overall sensitivity, specificity, negative predictive value, and positive predictive value of synovial alpha-defensin were 83%, 83%, 92%, and 64%, respectively.

CONCLUSION: In patients where the diagnosis of PJI is unclear because of recent antibiotic use, equivocal laboratory findings or suspected falsely negative or positive cultures, synovial fluid alpha-defensin can provide an additional data point to assist the clinician in determining if PJI is present.

Open Posterior Capsular Release with an Osteotome in Total Knee Arthroplasty: Neurovascular Structures at Risk

Abstract ID: Poster 102

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INTRODUCTION: Posterior capsular contracture is a potential consequence of osteoarthritis, post-traumatic arthritis, and surgical procedures of the knee. This can result in limited range of motion, gait problems, and pain. Many patients who undergo total knee arthroplasty will be found to have some degree of flexion contracture intraoperatively which necessitates posterior capsular release. There is no information in the literature about the safety of open posterior capsular release when used in total knee arthroplasty. The present cadaveric study investigates the safety of posterior capsular release during total knee arthroplasty.

METHODS: This study involved 10 fresh-frozen cadaver specimens, each of which underwent three successive penetrations of the posterior capsule medially, laterally, and in the midline. One senior joint surgeon performed this procedure with a 1.5 inch curved osteotome, hugging the bone posteriorly on the distal aspect of the femur until the osteotome moved freely behind the bone without resistance. We then measured the distance from the distal aspect of the femur to the tip of the osteotome. Finally, we dissected the popliteal fossa and followed the course of the neurovascular bundle to assess for injury.

RESULTS: In our study, the mean depth of penetration was 13.57 cm, which exceeds the standard depth of 5 to 10 cm required for posterior capsular release. Even at this depth, 0 of the 30 penetrating events resulted in injury to the artery, nerve, or vein.

CONCLUSION: These results demonstrate that posterior capsular release with an osteotome using a blunt technique is a safe procedure if performed using standard technique hugging the distal femur posteriorly.

Impact of Time-to-Surgery from Injury on Short-Term Clinical Outcomes in Periprosthetic Knee Fractures

Abstract ID: Poster 103

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INTRODUCTION: Periprosthetic fracture (PPF) is a serious complication that occurs in 0.3%-2.5% of all total knee arthroplasties. To our knowledge, there are no studies in the literature that evaluate the association between time-to-surgery after PPF and complication rate. This study tests our hypothesis that delayed time-to-surgery increases rates of short-term complications after PPF surgery.

METHODS: Our study cohort included patients undergoing PPF surgery in the ACS National Surgical Quality Improvement Program database (2006-2015). The patients were dichotomized based on time-to-surgery: Group 1 with time ≤ 2 days and Group 2 with time > 2 days. A 2-by-2 contingency table and Fisher's exact test were used to evaluate the association between complications and time-to-surgery.

RESULTS: This study identified 263 patients (210 female, 52 male, and 1 unknown) with a mean age of 73.9 ± 12.0 years. Group 1 had 216 patients; complications included 3 (1.4%) superficial infections (SI), 1 (0.5%) organ space infection (OSI), 1 (0.5%) wound dehiscence (WD), and 4 (1.9%) deep vein thrombosis (DVT). Group 2 had 47 patients; complications included 1 (2.1%) SI, 1 (2.1%) OSI, 1 (2.1%) DVT, and no WD. There was no significant difference in postoperative complications between the two groups. However, patients in Group 2 were more likely to receive a blood transfusion (27/47, 57.5%) than those in Group 1 (70/216, 32.4%) ($p=0.0013$).

CONCLUSION: Our study indicates patients with delayed time-to-surgery are more likely to receive blood transfusions, though there was no significant difference in postoperative complications (SI, OSI, WD, or DVT) between the two groups.

The Effect of Patellar Height on Outcomes of Patellofemoral Arthroplasty

Abstract ID: Poster 104

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BACKGROUND: The primary goal of patellofemoral arthroplasty (PFA) is to replace patellar and femoral trochlear cartilage in order to alleviate pain and restore native patellofemoral kinematics. In total knee arthroplasty (TKA) and unicompartmental knee arthroplasty (UKA), particular attention has been paid to radiographic parameters such as patellar height and its effect on patellar tracking. The purpose of this study was to evaluate the preoperative and postoperative patellar height using the Caton Deschamps (CD), Insall-Salvati (IS), and Blackburne-Peele (BP) radiographic measurement methods, and determine if patellar height had an effect on clinical outcomes and survivorship after PFA.

METHODS: We identified all patients who underwent PFA at a single institution by a single surgeon for isolated patellofemoral arthritis between 2002 and 2013. A total of 175 PFAs were performed. Of these, 169 knees in 134 patients met inclusion criteria. Preoperative and postoperative radiographs were measured by two separate observers for patellar height using the CD, IS, and BP methods. Clinical outcomes were assessed preoperatively and postoperatively using UCLA and Tegner activity scores. Kaplan-Meier curves were used to determine survivorship free from revision to TKA. Given that patella baja is a relative contraindication to PFA, the groups were separated into patella alta and non-patella alta.

RESULTS: The distribution of patellar height between groups was similar with all the measurement types with good inter-rater reliability (CD=0.81, IS=0.93, BP=0.85). Functional outcomes showed significantly larger increases in postoperative Tegner and UCLA scores in the non-patella alta group compared to the patella alta group ($p=0.03$, $p=0.03$). Preoperative and postoperative range of motion was similar between groups with no significant difference. The Kaplan Meier curves showed no significant differences in revision to TKA rates between the groups. Overall survivorship free from revision to TKA was 95%, 92%, and 82% at 1, 5, and 10 years, and survivorship free from any reoperation was 95%, 90%, and 80% at 1, 5, and 10 years.

CONCLUSIONS: There was a greater clinical benefit in patients undergoing PFA in those with a normal patellar height compared to those that had patella alta. There was no significant difference in overall survivorship as measured by revision to TKA. Similar to TKA and UKA, patellar height influences outcomes following PFA and should be considered a requisite part of the evaluation of candidates for PFA.

Evaluation of Psychosocial Parameters in Patient Satisfaction and Functional Outcomes After Patellofemoral Arthroplasty

Abstract ID: Poster 105

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BACKGROUND: Increasing evidence suggests that impaired mental health can affect patient satisfaction after total knee arthroplasty. A similar relationship may exist between mental health and outcomes after patellofemoral arthroplasty (PFA). The purpose of this study was to evaluate the impact of psychosocial parameters in patient satisfaction and functional outcomes after PFA.

METHODS: All patients who underwent PFA at a single institution by a single surgeon for isolated patellofemoral arthritis between 2002 and 2015 were reviewed. Psychosocial variables were assessed, including work status, smoking, current or prior narcotic use, current or prior antidepressant use, and current or prior psychiatric diagnosis. Preoperative clinical outcomes, including Knee Society scores (KSS) for pain and function, UCLA, and Tegner activity scores, and patient-perceived postoperative satisfaction scores were reviewed. Chi-squared analysis was used to compare factors affecting failure. To assess for the relationship between outcomes scores and various risk factors, a standard least squares multivariate model was constructed. Kaplan-Meier curves were used to determine survivorship free from revision to TKA.

RESULTS: A total of 75 PFAs in 55 patients were performed during the study period that met inclusion criteria (age > 18 years, minimum of 2 year clinical and radiographic follow-up). There were 66 females and 7 males. The mean age was 51 years. Mean follow-up was 3 years. Overall survivorship free from revision to TKA was 99%, 99%, and 97% at 1, 2, and 5 years. Current or previous narcotic use was associated with a smaller improvement in KSS pain scores (-13.5, 95% C.I. -21.8 to -5.2) and with smaller improvement in KSS function scores (-15.0, 95% C.I. -30.4 to -0.37). Similarly, increasing age at surgery was associated with a smaller improvement in KSS function scores (-1.2, 95% C.I. -2.4 to -0.02) and a smaller increase in UCLA activity levels (-0.1, 95% C.I. -0.14 to -0.03). Current or previous narcotic use (-13.5, 95% C.I. -21.8 to -5.2) and increasing BMI (-1.5, 95% C.I. -2.5 to -0.5) resulted in worse patient reported satisfaction scores. Increasing age at time of surgery increased the risk for failure (-8.83, CI 0.77 to 0.98).

CONCLUSIONS: Advanced age at surgery, current or previous narcotic use, current work disability, elevated BMI, and current smoking were found to adversely affect clinical outcomes following PFA. Current or previous narcotic use and elevated BMI resulted in worse patient-reported satisfaction scores. There was no association between antidepressant use or psychiatric diagnosis and worse clinical outcomes.

Does the Combination of Liposomal Bupivacaine and Bupivacaine HCl Enhance Postoperative Analgesia in Total Knee Arthroplasty?

Abstract ID: Poster 106

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INTRODUCTION: Approximately 700,000 total knee arthroplasties (TKA) are performed annually in the United States. Postoperative pain is significant and inadequate pain control can lead to poor functional recovery and patient satisfaction. The current multi-modal strategies for pain management include preoperative, intraoperative, and postoperative interventions. Bupivacaine HCL is a local anesthetic commonly used intraoperatively with effects extending into the postoperative period. Recently a depo-formulation of bupivacaine has been developed for long term pain relief that can be delivered intraoperatively. Since the depo formulation has a slower onset we questioned whether liposomal bupivacaine with bupivacaine HCL improved patient pain control postoperatively and decreased narcotic consumption.

METHODS: We retrospectively reviewed charts from 100 patients undergoing TKA. All patients received intra- and peri-articular local anesthetic injections. One group received 266 mg liposomal bupivacaine (Group LB). The other group received 266 mg liposomal bupivacaine combined with 50 cc of 0.25% bupivacaine HCL (Group LB+B). Both medications were injected using a standardized injection technique. All patients received the same multimodal analgesic regimen preoperatively, intraoperatively with spinal anesthesia and postoperatively. A retrospective review of the charts regarding patient demographics, length of stay, visual analogue scores, and narcotic use in the Post-Anesthesia Care Unit (PACU) specifically and throughout hospitalization was undertaken.

RESULTS: A total of 100 charts were reviewed. There were no statistically significant differences in patient demographics or length of stay between groups. The adjusted mean visual analog scores in the PACU (2.31 vs. 3.08, $p = 0.015$) and throughout the entire hospitalization (3.41 vs. 4.07, $p < 0.001$) were significantly lower in the LB+B group compared to the LB group alone. There were no significant differences in the amount of narcotics used between the groups. However, there was a trend towards decreased narcotic consumption in the LB+B group.

CONCLUSIONS: Perioperative pain management in TKA continues to evolve, in part driven by reducing hospital stays and improving patient satisfaction. Patients who received the combination injection had a statistically significant decrease in VAS in the PACU and throughout their overall hospitalization. There was no statistical difference in the secondary outcomes; however, the combination group showed a trend towards decreased narcotic consumption. Despite the statistical significance found with the combination group in VAS scores, the small difference in VAS scores forces us to question the clinical utility of this intervention. Further study with randomization may further delineate the effectiveness of combining short and long acting bupivacaine.

Complications of Tibial Tubercle Surgery

Abstract ID: Poster 107

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INTRODUCTION: Tibial tubercle osteotomy (TTO) is a common procedure that is frequently used in the treatment of patella alta, patellar instability, or patellar chondrosis. Medialization of the tubercle decreases the lateral force of the patella leading to improvement in stability. Distalization of the tubercle decreases patella height and corrects patella alta. Anteriorization has been shown to be an effective treatment to unload the patella when chondrosis of the patella is present. Current estimates of this procedures' complication rates range from 0-11%. Our hypothesis was that complication rate for tibial tubercle osteotomies is greater than 10%.

METHODS: One hundred twenty-five patients underwent tibial tubercle osteotomies with concomitant procedures including autologous cartilage implantation (ACI), trochleoplasty, medial patellofemoral ligament (MPFL) repair/reconstruction, and lateral retinacular release/lengthening. The minimum postoperative follow-up included was greater than 6 months. Major complications were defined as fracture of the tibia, deep infection requiring surgery, nonunion/delayed union, arthrofibrosis requiring manipulation under sedation and/or open lysis of adhesions, loss of fixation, and deep vein thrombosis (DVT) requiring three months' anticoagulant treatment. Minor complications were defined as removal of hardware, superficial infection, loss/decrease of cutaneous sensation, and wound dehiscence treated non-operatively.

RESULTS: The mean follow-up was 24 months. There were 61 TTO performed for patellofemoral instability, 24 for patellofemoral cartilage damage, and 37 for both instability and cartilage damage. The major complication rate was 24% and included fracture of tibia (4.0%), deep infection (0%), loss of fixation (2.4%), nonunion/delayed union (5.6%), DVT (2.4%), and arthrofibrosis (12.0%). Of arthrofibrosis, 46.7% of patients underwent concomitant intraarticular procedures and 53.3% concomitant extraarticular procedures. Intra-articular procedures refer to femoral ACI, microfracture of femur, and osteochondral allograft of femur. Extra-articular procedures include lateral retinacular release/lengthening, MPFL reconstruction, and medial imbrication. If both intra- and extra-articular procedures were performed, the patient was recorded as intra-articular.

The minor complication rate was 19% and included removal of hardware (16.0%), superficial infection (2.4%), loss/decrease of cutaneous sensation (5.6%), and wound dehiscence (0.8%).

Symptom progression/persistence was present in 51.2% of the total TTOs performed. This included persistent effusion treated by aspiration/corticosteroid injection, viscosupplementation, continued crepitus, and surgical intervention for continued symptomatology not involving the tibial tubercle.

CONCLUSION: The rate of total complication for TTO was found to be 43.2%, this is greater than the estimated rate of complication in current literature. This finding may redirect patient and

physician discussions regarding the risks of TTO, possibly changing follow-up surveillance and management.

Preoperative Opioid Use Independently Predicts Increased Risk of Early Revision of TKA

Abstract ID: Poster 108

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INTRODUCTION: There has been little research evaluating the impact of preoperative opioid use on risk of subsequent revision after primary total knee arthroplasty (TKA). The purpose of this study was to evaluate the impact of preoperative opioid use on the risk of early TKA revision.

METHODS: The Humana database was queried for unilateral TKA during the years 2007-2015. Patients were tracked for the occurrence of an ipsilateral revision TKA for 2 years following the index procedure. Factors analyzed for risk of early revision of TKA included preoperative opioid use, age (<50 vs. ≥ 50 years), sex, diabetes, anxiety/depression, chronic kidney disease (CKD), and obesity (BMI > 30kg/m²). Preoperative opioid use was defined as a history of opioid prescription filled within 3 months prior to primary TKA. Multivariate logistic regression analysis was utilized to determine odds ratios (OR) and corresponding 95% confidence intervals for risk of early revision after primary TKA.

RESULTS: In total, 35,894 primary TKA patients were analyzed and 1.2% (n = 413) had a revision TKA procedure within 2 years of the index surgery. Overall, 29.2% of patients had filled an opioid prescription within 3 months prior to TKA and met criteria for an opioid user. Female to male ratio was approximately 2:1 and 98.7% of patients were >50 years at time of surgery. Twenty-five percent patients were obese, 34.6% were diabetic, 6.7% were smokers, 12.7% had CKD, and 6.9% had anxiety or depression. Multivariate logistic regression demonstrated preoperative opioid users were significantly more likely to undergo early TKA revision than non-opioid users (1.6% vs. 1.0%, OR 1.5 [1.3-1.9], $p < 0.001$). Other patient factors that also significantly increased the risk of early TKA revision included younger age (3.6% vs. 1.1%, OR 2.5 [1.3-1.9], $p < 0.001$), smoking (2.1% vs. 1.1%, OR 1.7 [1.2-2.2], $p < 0.001$), and obesity (1.4% vs. 1.1%, OR 1.3 [1.01-1.6], $p = 0.04$).

DISCUSSION: This study identified that opioid use within three months prior to TKA independently predicts an increased risk of early revision surgery. This finding provides further support for national efforts to decrease unnecessary and inappropriate opioid prescribing. Further research is needed to evaluate if discontinuing opioids prior to surgery mitigates this risk.

Same Day Bilateral Total Knee Arthroplasty Candidacy Criteria Reduce Length of Stay and Facility Discharge

Abstract ID: Poster 109

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INTRODUCTION: For some patients, sBTKA presents a higher risk for mortality and postoperative complications. Thus, careful patient selection is paramount. We evaluate the effects that recommended sBTKA candidacy criteria from a large integrated healthcare system have on inpatient length of stay (LOS), discharge disposition, and 90-day all-cause complications.

METHODS: We retrospectively queried the institution's electronic records for all patients with International Classification of Diseases, Ninth Revision (ICD-9) code 27447 with bilateral surgery between 1/1/2013 and 12/31/2015. We collected patient demographics, comorbidities, LOS, discharge dispositions, and hemoglobin A1c labs. We manually reviewed all 90-day emergency room visits, admissions, and operating room encounters. The cohort was stratified by level of adherence to the following prespecified appropriate use criteria (AUC) from an institutional established carepath: (1) age under 70 years, (2) absence of cardiac disease ICD-9 codes (myocardial infarction, congestive heart failure, and arrhythmia), (3) controlled diabetes (hemoglobin A1c under 6.6%), and (4) body mass index (BMI) under 30 kg/m². We analyzed patients both dichotomously (meeting all four AUC vs other) and semi-continuously (0 for ideal candidate up to 4 worst candidate). Outcomes included LOS, 90-day all-cause complications requiring hospital services, and home versus facility discharge. Continuous variable means were compared between dichotomous groups with the student's t-test and analysis of variance for semi-continuous groups. Categorical variable proportions were compared with Chi squared analyses. Significance was set at $p < 0.05$ for all tests.

RESULTS: A total of 561 patients underwent sBTKA during the study period: 140 (25%) ideal candidates with AUC score 0, 299 (53%) with score 1, 105 (19%) with score 2, 14 (4%) with score 3, and 3 (1%) with the worst AUC candidacy score 4. Ideal candidates had the shortest mean LOS at 3.6 ± 1.2 days. LOS was significantly longer for patients with three or more risk factors compared to those with two or less (5.2 ± 4.3 vs. 3.8 ± 1.6 , $P < 0.001$). Ideal candidates had more home discharges than other patients (26% vs. 13%, $P < 0.001$). While there was no difference in 90-day all-cause complications between ideal and non-ideal candidates (13% vs. 16%, $P = 0.4$), medical complications trended strongly (6% vs. 11%, $P = 0.086$). Higher risk factor scores correlated with progressively more complications.

CONCLUSIONS: Following institutional appropriate use, guidelines for sBTKA decrease LOS, increase home discharge, and may decrease complication rates following sBTKA. Providers can use these results to inform consent for surgery and risk profile for sBTKA service lines.

Quadriceps and Hamstring Muscle Strength Improves After Unicompartmental Knee Arthroplasty

Abstract ID: Poster 110

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INTRODUCTION: The ability to reach functional capacity following knee arthroplasty is reliant on the strength of the quadriceps and hamstring muscles. Following total knee arthroplasty, weakness of these muscles can persist for up to one year postoperatively; however, this phenomenon is not well-studied in unicompartmental knee arthroplasty (UKA) patients. Therefore, we assessed: (1) quadriceps muscle strength, (2) hamstring muscle strength, (3) correlation to time of return, and (4) correlation to functional outcomes.

METHODS: A review of all patients with medial compartment osteoarthritis treated with UKA at a minimum of 1-year follow-up was performed. This yielded 26 patients (32 knees), comprising of 8 females and 18 males who had a mean age of 67 years (range, 47 to 83 years). Muscle strength was assessed pre-and postoperatively via handheld dynamometry. Functional outcomes were assessed using Knee Society Scores (KSS). Descriptive statistics were used to determine means and ranges for continuous variables. Comparisons of groups were performed by paired t-tests.

RESULTS: At a minimum 1 year postoperatively, quadriceps muscle strength was 27 Nm (range, 13 to 71Nm) and hamstring muscle strength was 19.5Nm (range, 7 to 81Nm). Quadriceps muscle strength increased by 40% ($p=0.002$) and hamstring muscle strength by 26% ($p=0.057$). The mean KSS pain was 97 points (range, 85 to 100 points) and mean KSS function was 90 points (range, 45 to 100 points) postoperatively. The mean range of motion at the final follow-up was 125° (range, 110° to 135°).

CONCLUSION: Within 1 year following UKA, patients can expect restoration of quadriceps and hamstring muscle strength with a corresponding functional improvement. Although long-term follow-up is warranted to determine sustainability, the short-term (minimum 1 year) results demonstrate excellent restoration of function.

Mepivacaine vs. Bupivacaine Spinal Anesthesia for Rapid Recovery Total Knee Arthroplasty: A Retrospective Review

Abstract ID: Poster 111

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PURPOSE: The purpose of this study was to compare spinal mepivacaine versus bupivacaine in patients undergoing primary total knee arthroplasty in order to establish the efficacy, safety, and recovery profiles of spinal mepivacaine for rapid rehab arthroplasty surgery, which has not been described in the literature.

METHODS: This was an IRB approved, retrospective review of a single surgeons patients undergoing primary unilateral total knee arthroplasty (TKA) between November 2015 and July of 2016. Anesthetic selection was not based on patient or surgical factors, and patients otherwise followed a strict and standardized perioperative protocol. There were a total of a 156 patients, 53 in the mepivacaine group and 103 in the bupivacaine group. Patients received spinal anesthesia in the operating room immediately before surgery. Mobilization occurred the afternoon of surgery. Patients were discharged home once they reached physical therapy goals, were voiding spontaneously, pain was controlled, and had complete return of motor and sensory function. The main outcomes measure was length of stay, and episodes of urinary retention. Pain control was assessed using visual analog scale (VAS), rate of consumption of opioid medication, as well as pain and distance ambulated with physical therapy.

RESULTS: The total length of stay was 5.5 hours shorter in the mepivacaine group (M=28.1 vs. B=33.6 hours, $p=0.002$). There were significantly less episodes of straight catheterization in the mepivacaine group (M=2/51 vs. B=15/103, $p=0.041$). Average VAS pain scores in the PACU were similar between the two groups (M=1.3 vs. B=0.5, $p=0.002$). The rate of morphine consumption per hour was slightly higher in the PACU for the Mepivacaine group (M=2.2 vs. B=0.8, $p=0.002$). The rate of consumption of morphine equivalents was not different after leaving the PACU or at any other time point. Physical therapists assessed pain again during physical therapy sessions and pain scores were similar between the two groups at all time points. There was a trend toward increased distance walked in the mepivacaine group with physical therapy on POD 0 (M=82 vs. B=53 feet, $p=0.109$) and POD 1 (M=187.5 vs. B=163.3, $p=0.08$). There were no episodes of blood transfusion, conversion to general anesthesia or transient neurologic symptoms in either group.

CONCLUSION: Mepivacaine is an excellent option for rapid recovery total knee arthroplasty with significantly less episodes of urinary retention and shorter length of stay compared to bupivacaine.

Patient Factors, Injury Patterns, Physical Examination, and Complications Are Unable to Reliably Predict Heterotopic Ossification Following Multiligament Knee Injuries

Abstract ID: Poster 112

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BACKGROUND: Multiligament knee injuries (MLKI) are complex injuries that are influenced by a multitude of patient and injury related factors. One complication that can nullify a reconstruction is heterotopic ossification (HO). This complication can be devastating and it is extremely difficult to predict. In the past, loose associations have been made between this complication and PCL reconstruction, but given limited patient populations, no strong associations have been made. Additionally, HO can largely be avoided with local radiation to the site. Therefore, if HO can be predicted in multiligament knee injuries, then a focused patient population can be identified to receive this prophylactic therapy.

METHODS: The cohort consisted of 132 patients and knees that were treated at a single institution from 1/1/2005 through 12/31/16 by a single surgeon. Data was prospectively gathered and retrospectively reviewed and extracted from a multiligamentous knee injury database. Inclusion data included patients who underwent a reconstruction or repair and had minimum of 1-year follow-up. Demographic information including age, gender, BMI, smoking and alcohol use. Primary outcome measures of Heterotopic ossification score (HO) by x-ray and secondary outcome measures of HO correlation with co-morbid injuries, laxity of the joint, and range of motion scores were collected for all patients. Complication data was captured including superficial and deep infection, peroneal nerve palsy, amputation, arthrofibrosis, compartment syndrome, persistent pain, persistent instability, and other complications to intervention.

RESULTS: 109 patients met inclusion criteria. Average age was 34.0 years. There were 45 females and 74 males. Overall incidence of HO was 32.1%. 74 patients were found to have grade 0 HO, 29 patients had grade 1 HO, 4 had grade 2 HO, 1 had grade 3 HO, and only 1 had grade 4 HO. Of all the data points that we collected, no patient factors, injury patterns, physical examination findings, or complications were able to predict the formation of heterotopic ossification.

CONCLUSION: Based on the data in this study, there are no factors that are able to reliably predict the presence of heterotopic ossification following surgical management of multiligament knee injuries.

Interface Interrogation of Total Knee Arthroplasties Using Ultrasound Vibrometry

Abstract ID: Poster 113

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INTRODUCTION: Aseptic loosening is the second leading cause for total knee arthroplasties (TKA) to fail and require revision surgery. Fluoroscopically-guided radiography is the gold standard for detecting loosening, but this method is not perfect (sensitivity: 59 – 85%). The purpose of this study was to develop an ultrasonic model and technique to investigate the bone-cement-implant interface in TKA to help diagnose aseptic loosening prior to detection on conventional radiographs.

METHODS: Total knee arthroplasties were implanted in cadaveric knee specimens by an orthopedic surgeon. In the well-fixed group, components were cemented in place in the usual fashion. In the cement-bone debonded group, a layer of ultrasound gel was introduced onto the prepared bone surface prior to cementation. Post-surgical fluoroscopically-guided images were acquired in both groups. Ultrasound vibrometry was used to measure interface motion in total knee arthroplasties in both groups.

RESULTS: In both groups, the fluoroscopic images showed no evidence of interface debonding or loosening. In the cement-debonded group, ultrasonic vibrometry showed significant motion and movement at the cement-bone interface consistent with loosening. 3D ultrasound reconstructions could display defects and microsurface characteristics in real-time on clinical ultrasound machines.

DISCUSSION/CONCLUSION: Ultrasound vibrometry may have a role in detecting motion at interfaces in TKA. The implant-cement-bone interfaces are a site of mechanical failure in aseptically loosened TKAs that are often missed on radiographs. Micromotion-based ultrasound was able to detect statistically significant differences between well-fixed and loose total knee TKAs in this cadaveric study. Further studies are warranted to see if ultrasound techniques can detect aseptic loosening clinically before conventional radiographic detection.

Early Results of a Porous Titanium Cone and a Novel Ream-Preparation Technique in Complex Revision Total Knee Arthroplasty (TKA) with Significant Tibial Bone Loss

Abstract ID: Poster114

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BACKGROUND: The modern strategy for addressing tibial bone loss in revision total knee arthroplasty is to obtain cementless metaphyseal fixation. The goal of this study was to evaluate early radiographic results and assess for clinical failure in revision TKA using a porous titanium tibial cone implanted with a novel ream-preparation technique.

METHODS: We performed a retrospective review of a prospectively collected database between 6/2015 and 5/2016 to identify revision TKAs utilizing a porous titanium cone implanted with a novel ream-preparation technique. Tibial bone loss was classified using the Anderson classification based on preoperative radiographs and operative dictations. Cones were utilized to augment fixation due to metaphyseal bone loss compromising keel engagement and rotational stability of the revision tibial component. We analyzed 1-month, 4-month, and 1-year anteroposterior and lateral radiographs for changes in coronal and sagittal implant position, evidence of tibial cone/component subsidence, evidence of bone ingrowth, and progressive zonal lucency, utilizing the Modern Knee Society Radiographic Evaluation System.

RESULTS: We identified 21 cones implanted in 20 patients (6 male, 14 female). Average age and BMI were 60.8 years and 32.6 respectively. Indication for revision TKA was re-implantation (7/21), aseptic tibial loosening (8/21), and global/flexion instability (6/21). Tibial bone loss was classified as IIA in 10/21 cases (47.6%), IIB in 7/21 cases (33.3%), and III in 4/21 (19.0%). Average radiographic follow-up of the cohort was 1.2 years (0.9-1.7 years). At a mean of 1.2 years follow-up, 19/21 cones demonstrated clear evidence of radiographic bone integration. While 2/21 (9.5%) of patients demonstrated radiographic evidence concerning for potential failure of integration, these patients were not subjectively symptomatic and there were no clinical failures for aseptic tibial loosening requiring revision surgery. Three patients (14.3%) requiring re-operation in the follow-up period (one recurrent infection, two with progressive ligamentous instability) demonstrated bony ingrowth of the tibial cone at time of revision.

CONCLUSIONS: Early radiographic results of an additive manufactured porous titanium cone implanted with a novel ream-preparation technique demonstrated excellent ingrowth in 90% of complex revision TKAs with significant tibial bone loss. The ream-preparation technique resulted in excellent apposition of the porous surface to bone. Tibial preparation in this manner may result in increased simplicity, decreased OR time, and decreased variability due to surgeon experience. While our early experience is promising, longer follow-up is warranted.

Risk Factors for Recurrent Patellar Instability in Children and Adolescents

Abstract ID: Poster 115

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BACKGROUND: Acute patellar dislocation is the most common traumatic injury about the knee in young, active patients, and it is challenging to treat. Recurrence rates are high and carry a substantial risk of irreparable cartilage damage, predisposing patients to future patellofemoral arthritis. The goal of this study is to describe factors associated with ipsilateral recurrent patellar instability in adolescent patients after first-time patellar dislocation.

METHOD: The study included a cohort of adolescent patients, who experienced a first-time patellar dislocation between 2007 and 2016. Information related to demographics, initial injury, treatment, and outcomes were retrospectively recorded. Radiographic parameters assessed on MRI included patellar height, patellar shape, trochlear dysplasia, and skeletal maturity. Parameters were compared using chi-square or Fisher's exact test for categorical variables and two sample t-tests for continuous variables. Univariate cox proportional hazards model for time to outcome data and multivariate regression were used to determine risk factors.

RESULTS: 122 knees in 110 patients, 66% females, with an average age of 14.3 ± 2.8 years at time of treatment were included. Average follow-up was 2.6 ± 1.6 years. Of the 122 knees, 111 (91%) were treated non-operatively and 11 (9%) were treated surgically. Of the 111 non-operatively treated knees, 68 (61.3%) had a recurrence within 0.99 ± 0.94 years post-initiation of non-operative treatment. Skeletally immature knees had a 72% recurrence rate compared with a 51% recurrence rate in skeletally mature knees ($P=0.025$). Of the 68 knees with re-dislocation, 32 subsequently required surgery. Univariate analysis revealed the following risk factors for recurrence: younger age ($HR=0.897$, 95% $CI=0.82-0.98$, $P=0.015$), skeletal immaturity ($HR=1.811$, 95% $CI=1.10-2.98$, $P=0.020$), family history of patellar instability ($HR=3.101$, 95% $CI=1.12-8.59$, $p=0.029$) and history of contralateral patellar instability ($HR=1.652$, 95% $CI=1.02-2.67$, $P=0.041$). Radiographic risk factors included increased patellar height (Blackburne-Peel ratio; $HR=3.828$, 95% $CI=1.07-13.75$, $P=0.040$) and trochlear depth <3 mm ($HR=13.493$, 95% $CI=1.62-112.08$, $P=0.016$). Patellar tilt, sulcus angle, TT-PCL or TT-TG were not different between patients with and without recurrence. Multivariate analysis revealed a trochlear depth <3 mm ($HR=36.691$, 95% $CI=3.83-351.16$, $P=0.002$) and increased patellar height (Blackburne-Peel ratio; $HR=5.710$, 95% $CI=1.04-31.44$, $P=0.045$) as independent risk factors for recurrence.

CONCLUSION: We found that younger age, skeletal immaturity, positive family history, contralateral patellar instability, increased patellar height and reduced trochlear depth were all significant risk factors for recurrence in patients with first-time patellar dislocations. This information will help to counsel patients and their families after first-time patellar dislocation about prognosis, treatment options, and potential long-term outcomes.

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Dwyer, Emma P.	n
Edgerton, Michael T.	n
Edmiston, Tori A.	n
Edwards, Paul K.	1, 3b – DJ Orthopaedics
El Atrouni, Wissam	n
ElAttrache, Neal S.	1, 2, 5 – Arthrex, Inc.; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Elhassan, Bassem T.	n
Elias, John	n
Ellerman, Jutta	n
Elliot, Marilyn	n
Ellis, Henry B., Jr.	3b – Smith & Nephew; 6 – Allosource, Ossur, Vericel
Ellman, Michael B.	3b - Stryker
Engasser, William M.	n
Erb, Eric	n
Estrera, Kenneth A.	n
Eustler, Eric P.	n
Evans, Timothy J.	n
Everhart, Joshua S.	n
Fahs, Adam	n
Fairchild, Ryan	n
Fehring, Thomas K.	1, 2, 3b, 5 – DePuy, a Johnson & Johnson Company
Faour, Mhamad	n
Featherall, Joseph	n

Ferguson, Peter C.	n
Fice, Michael P.	n
Fidai, Mohsin S.	n
Fillingham, Yale A.	3b – Johnson & Johnson
Finnan, Ryan P.	n
Fisk, Felicity	n
Fitz, David W.	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.
Flynn, Jack M.	1 – Biomet; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Foltz, Carol	n
Foran, Jared R. H.	3b - Zimmer
Force, Erica	n
Ford, Amy N.	n
Forehle, Andrew W.	n
Fornari, Eric D.	n
Fortin, Paul T.	3b – Smith & Nephew, Stryker, Wright Medical Technology, Inc.; 5 – Musculoskeletal Transplant Foundation
Fournier, Matthew N.	n
Francis, Tittu	n
Francois, Elvis L.	n
Fras, Andrew	n
Freedman, Brett A.	n
Frisch, Nicholas B.	2 – 3M; 4 - PeerWell
Froehle, Andrew W.	n
Fruehling, Catherine	n
Furdock, Ryan	n
Gaal, Benjamin	n
Gabbard, Michael D.	n
Gallaway, Kathryn	n
Gandhi, Sapan D.	6 – Stryker, Synthes
Gao, Yubo	n
Garbis, Nickolas G.	n
Gardner, Michael J.	2, 3b – KCI; 3b – Biocomposites, BoneSupport AB, Globus Medical, Pacira Pharmaceuticals, StabilizOrtho; 3b, 4 – Conventus; 3b, 5 – Synthes; 4 – Imagen Technologies; 5 – Medtronic, SmartDevices, SMV Medical; 7 – Journal of Bone and Joint Surgery-American, Wolters Kluwer Health – Lippincott Williams & Wilkins
Garrison, Robert L.	n
Garrone, Andrew J.	n
Garvin, Kevin L.	n
Gary, Joshua L.	2 – Smith & Nephew; 4 – Summitt Medventures; 5 – AO North America, Microbion
Gebrelul, Aaron	n
Gengler, Seth R.	n
George, Jaiben	n
Gerlinger, Tad L.	3b, 5 – Smith & Nephew; 4 - Theracell
Gheraibeh, Petra	n
Gholson, J. Joseph	n
Gibbs, Daniel B.	n
Gilchrist, Scott	n

Giveans, M. Russell	3b – Ortholink Pty Ltd.
Glass, Natalie A.	n
Godoy dos Santos, Alexandre	2 – Merck, Sanofi-Aventis
Goetz, Jessica	5 – Mortise Medical
Goitz, Henry T.	n
Gombosh, Michael R.	n
Gonzales, Jasmine L.	n
Gonzalez, Mark H.	1 – Biomet, Johnson & Johnson, Zimmer; 3b – Smith & Nephew; 4 – Ortho Sensing Technology
Goodson, Kevin M.	n
Gothard, M. David	n
Gould, Greg	n
Goyal, Kanu S.	n
Graham, R. David	n
Grant, Tanner W.	n
Grauer, Jonathan N.	3b - Bioventus
Grawe, Brian M.	n
Graziano, Gregory P.	3c – Medtronic Sofamor Danek
Green, Adam M.	n
Greene, Renee S.	n
Greer, Jordan W.	n
Griscom, James	n
Gross, R. Michael	n
Grozenski, Andrew M.	n
Guanciale, Anthony F.	n
Guest, John-Michael	n
Gulledge, Caleb	n
Guo, Eric	n
Gupta, Munish C.	1, 2, 3b – DePuy, a Johnson & Johnson Company; 4 – Johnson & Johnson, Proctor & Gamble
Gurd, David P.	n
Guthrie, S. Trent	n
Haider, Hani	2, 3b, 3c, 4 – Trak Surgical Inc.; 3a, 3b, 4 – HTC Services LLC; 3b – AMTI, Inc.; 3b, 5 – Biomet; 4 – SI-Bone, Softjoint; 5 – Arthrex, Inc., New York University, University of Tokyo
Hakeos, William M.	n
Hall, Brian W.	n
Hall, Jacob T.	n
Hallock, Justin D.	n
Halsey, David A.	n
Halverson, Stacey	n
Hamersma, Zachary P.	n
Han, Shuyang	n
Hanley, Jessica M.	n
Hannon, Charles P.	n
Hansen, Benjamin	3a – Forest Pharmaceuticals, Myriad Genetics
Hanssen, Arlen D.	1 – Stryker; 7 – Elsevier
Hanstein, Regina	n
Hariri, Omar	n
Harold, Ryan E.	n
Harrington, Melvyn A.	2 – Fidia Pharma; 3b – KCI, Zimmer
Harris, Joshua D.	2, 3b – Ossur; 2, 3b, 5 – Smith & Nephew; 3b – NIA Magellan; 5 – DePuy, a Johnson & Johnson Company; 7 – SLACK Incorporated
Hartigan, David E.	3b – Arthrex, Inc.

Hartman, Curtis W.	2, 3b, 5 – Smith & Nephew; 5 – Pfizer
Hausman, Michael R.	2 – Trimed; 4 – Checkpoint Surgical, NDI Medical, SPR Therapeutics; 3c – Skeletal Dynamics
Hawkins, Richard J.	1 – Ossur; 3b – Arthrex, Inc.; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Healey, John H.	3b – Daiichi; 3c – Illuminoss; 7 – Clinical Orthopaedics and Related Research
Heddings, Archie A.	n
Heidenreich, Mark J.	n
Heigle, Gregory	n
Heineman, Nathan D.	n
Helfrich, Mia	n
Hellman, Michael D.	n
Helsper, Elizabeth A.	n
Hendricks, Kelly J.	2 – Johnson & Johnson
Hendrickson, Nathan R.	n
Hereford, Timothy E.	n
Hernandez, Nicholas M.	n
Herring, Matthew	n
Hess, Matthew	n
Hettrich, Carolyn M.	5 - Tornier
Hevesi, Mario	n
Hidden, Krystin A.	n
Higgins, John D.	n
Hightower, William	4 - Theranos
Higuera, Carlos A.	2, 3b, 5 – KCI; 3b – Pfizer, TenNor Therapeutics Limited; 3b, 6 – Zimmer; 5 – 3M, CD Diagnostics, Cembra, Cymedica, Ferring Pharmaceuticals, Myoscience, OREF, Orthofix, Inc., Pacira, Stryker
Hinckel, Betina B.	n
Hoegler, Joseph J.	n
Hoel, Ryan J.	n
Hogue, Grant D.	4 – Tether Implant Corporation
Hogue, Matthew H.	n
Hollnagel, Katharine	n
Holzmeister, Adam	n
Hood, Mark	n
Hooda, Zamaan	n
Hooke, Alexander W.	n
Hopkinson, William J.	4 – Johnson & Johnson, Pfizer, Zimmer
Horberg, John V.	n
Horn, Brandon	n
Hornicek, Francis J.	3b – Globus Medical; 3b, 5 – Stryker; 4 – Biome AI, Inc., Bone Solutions, Inc.; 6 – Biomet; 7 – Amyrsis, McGraw Hill, UpToDate, Wiley
Hosseinzadeh, Pooya	n
Houdek, Matthew T.	n
Hsu, Alan	n
Hsu, Wellington K.	1, 3b – Stryker; 2, 3b – AONA; 3b – Allosource, CeramTec, Globus Medical, Graftys, Medtronic Sofamor Danek, Mirus, RTI, Xtant; 5 - Medtronic
Hu, Jennifer C.	n
Hudson, Ian	n
Hudson, Parke W.	n
Huebner, Stephen	n
Hughes, John	n

Hughes, Langston	n
Huntley, Sam R.	n
Huo, Michael H.	3b – AO Foundation, B-One Orthopedics, Implantcast
Inabathula, Avinash	n
Incavo, Stephen J.	1 – Innomed, Kyocera, Osteoremedies, Smith & Nephew, Wright Medical Technologies, Inc.; 1, 3b – Zimmer; 4 – Nimbic Systems
Ireland, Philip H.	n
Israel, Heidi	n
Jabara, Michael R.	n
Jack, Robert	n
Jain, Margaret K.	n
James, Christopher	n
Jaquith, Bradley P.	n
Jastifer, James R.	3b - Stryker
Jawad, Michael	n
Jaykel, Matthew N.	n
Jeans, Kelly	n
Jenkins, Tyler J.	n
Jewett, Brian A.	n
Jildeh, Toufic R.	n
Jimenez, Andrew E.	n
Jo, Chan-Hee	n
Johnson, Jayson C.	n
Johnson, Jeffrey E.	1, 3b – Wright Medical Technologies, Inc.; 3c, 4 – Crossroads Medical; 4 – Extremity Development Corporation; 6 – Arthrex, Inc.- Institutional Support for Fellowship, OMEGA
Johnson, Joshua D.	n
Johnson, Nicholas R.	n
Jonah, David	n
Jonard, Brandon W.	n
Jones, Kerwyn C.	3b - OrthoPediatrics
Jones, Richard E.	1 – Innomed; 1, 2, 3b, 4 – DePuy, a Johnson & Johnson Company; 4 – Kinamed, omni scientific
Jouret, Jill E.	n
Joyce, Cara	n
Kadado, Allen	n
Kadri, Omar	n
Kahn, Adam	n
Kakar, Sanjeev	3b – Arthrex, Inc., Skeletal Dynamics; 4 – Sonex Healthcare
Kakazu, Rafael	n
Kalra, Kunal	n
Kampa, John	n
Kaplan, Lige	3b – Stryker
Karadsheh, Mark S.	7 - Orthobullets
Karam, Matthew D.	4 – Mortise Medical LLC
Kaste, Sue C.	n
Kay, Andrew B.	n
Kee, James R.	n
Keeney, James A.	n
Keller, Robert A.	n
Kelly, Anne M.	n
Kelly, Mick	n
Kenter, Keith	1, 3c – Schwartz Biomedical
Kern, Andrew	31, 4 – Astellas Pharmaceuticals

Keswani, Aakash	n
Khalil, Lafi	n
Khan, Adam Z.	n
Khan, Taleef R.	n
Khazzam, Michael S.	2 – Arthrex, Inc.; 2, 5 – Wright Medical Technology, Inc.
Kheir, Matthew	n
Kheir, Michael M.	n
Khlopas, Anton	n
Killen, Cameron J.	n
Kim, Isaac	n
Kim, Walter	n
Kirschner, Noah	n
Kiskaddon, Eric M.	n
Kissenberth, Michael J.	3b, 6 – Arthrex, Inc.; 6 – Arthrocare, Arthrosurface, Breg, DJ Orthopaedics, Greenville Hospital System, Neurotech, Pacira, Smith & Nephew
Klein, Sandra E.	n
Klika, Alison K.	n
Knapik, Derrick M.	n
Kogan, Monica	n
Kolowich, Patricia A.	n
Konigsberg, Beau S.	n
Kopits, Steven E. (deceased)	n
Kopydlowski, Nathan J.	n
Koso, Riikka E.	n
Koueiter, Denise M.	n
Kourtjian, Evan W.	n
Krause, Andrew	n
Krebs, J. Collin	n
Krebs, Victor E.	1, 2, 3b - Stryker
Kreder, Hans J.	3b, 5 – DePuy, a Johnson & Johnson Company; 5 – Biomet, Zimmer; 7 – AO North America, Elsevier Publishing
Krishnamurthy, Anil	n
Kroin, Ellen V.	n
Kroll, Henry	n
Kruckeberg, Bradley M.	n
Krumm, Drew B.	n
Krych, Aaron J.	1, 3b – Arthrex, Inc.; 3b – Vericel; 5 – Aesculap/B. Braun, Arthritis Foundation, Ceterix, Histogenics
Kuroki, Keiichi	n
Kurowicki, Jennifer	n
Kuzma, Scott A.	n
Kvitne, Ronald S.	n
Kwapisz, Adam	n
Kyle, Richard F.	1 – DJ Orthopaedics, Smith & Nephew, Zimmer
La Fontaine, Javier	2 – TEI Biosciences Inc.
Labaran, Lawal	n
Lake, Samuel	n
Lalli, Trapper	n
Lamplot, Joseph D.	n

Laughlin, Richard T.	2 – AO North America, Smith & Nephew, Synthes; 3b – Premier Health Partners Orthopaedic Institute, South Surgery Center, LLC, World Arthritis Organization; 3c – Community Tissue Bank; 5 – AOFAS (Grants), Ohio Third Frontier, OTA, Wright State University Boonshoft School of Medicine
Lavery, Lawrence A.	2 – Integra, Osiris, Smith & Nephew; 3b – Ailon Medical Users, Harbor MedTech, HyperMed, PodoMetrics; 3b, 5 – KCI; 5 – Cardinal, GlaxoSmithKline
Lawler, Ericka A.	n
Lawton, Cort D.	n
Leafblad, Nels D.	n
Le, Theodore Toan	n
Leary, Emily V.	n
Leddy, Lee R.	5 - KCI
LeDuc, Ryan	n
Lee, Jessica H.	n
Lee, Julia	n
Lee, Kyle R.	n
Lee, Sung	n
Lehtonen, Eva J.	n
Lempert, Nathaniel	n
Les, Clifford	n
Levin, Jay	n
Levine, Brett R.	3b – Link Orthopaedics, McGraw-Hill, Merete; 5 – Artelon, Biomet, Zimmer
Levy, Bruce A.	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, Laura W.	1, 5 – Zimmer (family member); 2 – Osteotech (family member); 3b, 4 – Pipeline Biomedical (family member)
Lewis, Caroline	n
Lewis, Robert B.	n
Lewis, Thomas R.	n
Li, Bernard	n
Li, Daniel	n
Li, Xing	n
Light, Terry R.	n
Lim, Sungho	n
Lima, Diego	n
Limpisvasti, Orr	3b – Arthex, Inc.; 4 – CONMED Linvatec
Lin, Chia-Ying	n
Liu, George T.	3b – Gramercy Extremity Orthopedics
Liu, Jane Z.	n
Liu, Ramond W.	6 – Royalties paid to my institution, part of which are placed into a research fund that I control
Liu, Steve S.	n
Lizzio, Vincent	n
Lock, Terrence R.	n
Lonner, Jess H.	1, 2, 3b, 5 – Biomet, Smith & Nephew, Zimmer; 4 – Blue Belt Technologies, Healthpoint Capital; 7 – Saunders/Mosby-Elsevier, Springer, Wolters Kluwer Health – Lippincott Williams & Wilkins
Louie, Philip K.	4 - StreaMD
Lovro, Luke R.	n

Lovy, Andrew J.	n
Lu, Michelle Keyin	n
Ludtke, Stephanie L.	n
Luna, Jeffrey T.	n
Lundeen, Anna	n
Lynch, Jonathan	n
Mabry, Tad M.	n
Macalena, Jeffrey A.	n
Macatee, Bill	n
Macleod, Jonathan	n
Madden, Tyler S.	n
Magnussen, Robert A.	5 - Zimmer
Mahan, Michael C.	n
Mahoney, Craig R., Chair	4 – Trak Surgical, Inc.; 5 – Johnson & Johnson, Smith & Nephew
Makhni, Eric C.	7 - Springer
Malkani, Arthur L.	1, 2, 3b, 5 - Stryker
Malone, Kevin J.	3a – Three Rivers Orthopaedic and Spine, Inc. (brother is employee)
Malpani, Rohil	n
Maltenfort, Mitchell G.	n
Mangold, Devin R.	n
Manista, Gregory	n
Manning, David W.	1, – Biomet; 2, 3b – Medacta
Mardjetko, Steven M.	1, 3b, 4 – Spinecraft Corporation; 3b – Nuvasive
Markel, David C.	1, 2, 3b, 5 – Stryker; 2 – Halyard; 4 – Arboretum Ventures, The CORE Institute; 5 – OREF, US Veteran Administration
Maroto, Medardo	2 – Synthes; 5 – Smith & Nephew
Marsh, J. Lawrence	1 – Biomet, Tornier; 4 – FxRedux; 7 – Oxford Press
Marshall, Nathan E.	n
Martazavi, Shabnam	n
Martin, Case W.	n
Martin, Jill	n
Martin, John R.	n
Mascarenhas, Daniel	n
Mascioli, Anthony	3b – Medtronic, Olympus Endoscopy, Smith & Nephew
Maskill, John D.	3b – Wright Medical Technology, Inc.; 5 - Pfizer
Matar, Robert	n
Matava, Matthew J.	3b – Schwartz Biomedical; 6 – Arthrex, Inc., Breg
Mathews, Chelsea S.	n
Mathson, Kristin	n
Mazmudar, Aditya	n
Mazzone, Steven	n
McAnany, Steven	n
McAndrew, Christopher M.	3b - Zimmer
McCarthy, Conor	n
McCarthy, Michael H.	n
McCarthy, Richard E.	1, 2, 3b, 7 - Medtronic
McCarthy, Tom	3a, 4 - Stryker
McCormick, Jeremy J.	2, 3b, 5, 6 – Wright Medical Technology; 5, 6 – Midwest Stone Institute; 6 – Arthrex, Inc.
McCulloch, Patrick C.	2 – Vericel; 5 – Arthrex, Inc., DePuy, a Johnson & Johnson Company
McDermott, Scott E.	n
McDonough, E. Barry	n
McGwin, Gerald	n
McIntosh, Amy L.	2 – Globus Medical

McLain, Robert F.	3b – SI Bone
McLaughlin, Jeffrey R.	1, 2, 3b, 5 - Biomet
McLaughlin, Richard J.	n
McNeely, Emmanuel	n
McQuivey, Kade	n
Mears, Simon C.	n
Meehan, Robert E.	n
Meeks, Brett D.	n
Meheux, Carlos J.	n
Mehrotra, Kapil G.	n
Meinerz, Carolyn M.	n
Mells, Anthony	n
Melugin, Health P.	n
Meneghini, R. Michael	1, 3b – Osteoremedies; 1, 3b, 5 – DJ Orthopaedics; 4 – Emovi, MuveHealth, PixarBio
Menendez, Mariano	n
Messamore, William G.	n
Messingschlager, Cory J.	n
Messner, William	n
Meta, Fabien	n
Michael, Rachel	n
Michael, Raman	n
Mignemi, Megan	n
Mijic, Dragomir	n
Mikesell, Timothy A.	n
Mikhail, Christopher	n
Milbrandt, Todd A.	3b – Orthopediatrics; 4 – Viking Scientific; 6 - Broadwater
Miller, Blake W.	n
Miller, Evan	n
Miller, Taylor	n
Mills, Emily S.	n
Mirhaidari, Gabriel	n
Mitchell, Scott A.	n
Moeller, Amy T.	n
Molloy, Robert M.	2, 3b, 5 – Stryker; 5 – Zimmer
Momaya, Amit M.	n
Mont, Michael A.	1 – Microport; 1, 3b, 5 – Stryker; 3b – Abbott, Cymedica, Mallinckrodt Pharmaceuticals, Pacira, Performance Dynamics Inc., Sage; 3b, 5 – DJ Orthopaedics, Johnson & Johnson, Ongoing Care Solutions, Orthosensor, TissueGene; 4 – Peerwell; 5 – National Institutes of Health (NIAMS & NICHD)
Montgomery, Corey O.	n
Moon, Andrew S.	n
Moor, Molly	n
Moore, Drew D.	n
Moran, Steven L.	1, 3b – Integra; 4 – Axogen; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Morcuende, Jose A.	3c – Clubfoot Solutions
Morehouse, Hannah	n
Morell, Sean M.	n
Morgan, Patrick M.	n
Mormino, Matthew A.	n
Morscher, Melanie	n
Motisi, Matthew	n

Mott, Michael P.	n
Moutzourous, Vasilios	n
Muh, Stephanie J.	3b – DePuy, a Johnson & Johnson Company, Exactech, Inc.
Mulligan, Ryan P.	n
Munz, John W.	2 – Smith & Nephew, Synthes
Murphy, William G.	3b – Arthrex, Inc.; 3b, 6 – Wright Medical Technology, Inc.; 6 – Smith & Nephew
Murray, Trevor G.	3b – Zimmer
Murthy, Naveen	n
Nam, Denis	3b – Stryker, Zimmer; 3b, 5 – KCI; 4 – OrthAlign Inc., Synotrac Inc.
Nandi, Sumon	n
Napier, Kelby	n
Naranje, Sameer M.	n
Nassr, Ahmad N.	3c – Vikon Surgical; 5 – AO Spine, Pfizer, Synthes
Naveen, Neal B.	n
Neel, Michael D.	3b – Microport Orthopaedics, Orthoremedies, Wright Medical Technology, Inc.
Nelsen-Freund, Edward M.	n
Nelson, Andrew	n
Nelson, Clay G.	n
Nenadic, Ivan Z.	n
Nepple, Jeffrey J.	2, 3b – Ceterix Orthopaedics; 2, 3b, 5 – Smith & Nephew; 3b – Responsive Arthroscopy; 5 - Zimmer
Ness, Kiri K.	n
Nessler, Joseph P.	1, 2, 3b, 4, 6 – Stryker; 4 – US Patent Innovations, Vomaris
Nestorovski, Douglas L.	n
Neumann, Julie A.	n
Newgren, Jon M.	n
Newman, Jared M.	n
Newman, Jessica R.	n
Newton, Eric	n
Nguyen, Tram	n
Nho, Shane J.	1, 3b – Ossur; 3b, 5 – Stryker; 5 – Allosource, Arthrex, Inc., Athletico, DJ Orthopaedics, Linvatec, Miomed, Smith & Nephew; 7 - Springer
Ni, Ming	n
Nicholas, Richard W.	6 – Musculoskeletal Transplant Foundation
Nicholson, Gregory P.	1 – Innomed; 1, 3b – Wright Medical Technology, Inc.; 2 – Arthrosurface; 3b - Tornier
Nicolaou, Daameon	n
Nicolay, Richard W.	n
Nielsen, Ena	n
Nissi, Mikko J.	n
Noble, Philip	1 – Stryker; 1, 3b, 5 – Zimmer; 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
North, W. Trevor	n
Novack, Amanda J.	n
Nuelle, Clayton W.	n
Nuelle, Julia A. V.	n

Nunley, Ryan M.	1, 3b – Microport; 3b – Biocomposites, Cardinal Health, Halyard, Medtronic, Mirus; 3b, 5 – DePuy, a Johnson & Johnson Company, Medical Compression Systems, Inc., Smith & Nephew; 5 – Biomet, Stryker
Nwelue, Emmanuel	n
Nystrom, Lukas M.	n
O'Brien, Michael C.	n
Odum, Susan M.	6 – Universal Research Solutions, LLC
Okoroafor, Ugochi C.	n
Okorooha, Kelechi R.	n
Ollivier, Matthieu	n
Osborn, Patrick	n
Osmani, Feroz	n
O'Toole, Robert V.	1, 3b – Coorstek; 3b – Smith & Nephew; 3b, 4 – Imagen; 5 – Stryker, Synthes
Owen, Robert	n
Owens, Jessell M.	n
Oyer, Mark A.	n
Ozelie, Rebecca	n
Padgett, Ellen	n
Padley, Michelle A.	n
Pagnano, Mark W.	1 – DePuy, a Johnson & Johnson Company, Stryker
Pallante, Graham D.	n
Pally, Elliott M.	n
Palmisano, Andrew	n
Panattoni, Joao	n
Pareek, Ayoosh	n
Parekh, Amit	n
Parry, Joshua A.	n
Parson, Theodore W., III	n
Parsons, Bradford O.	1, 2, 3b – Arthrex, Inc.; 7 – Journal of Bone and Joint Surgery-American
Parvizi, Javad	1, 3b, 4 – Corentec; 3b – CeramTec, ConvaTec, Ethicon, Heron, Tenor, TissueGene, Zimmer; 4 – Alphaeon, Ceribell, Cross Current Business Intelligence, Hip Innovation Technology, Intellijoint, Invisible Sentinel, Joint Purification Systems, MDValuate, MedAp, MicroGenDx, Parvizi Surgical Innovations, Physician Recommended Nutraceuticals, PRN-Veterinary; 7 – Datatrace, Elsevier, Jaypee Publishers, SLACK Incorporated, Wolters Kluwer Health – Lippincott Williams & Wilkins
Pascual-Garrido, Cecilia	n
Pashuck, Troy D.	n
Pate, Matthew J.	n
Patel, Alpesh A.	1, 3b – Nuvasive, Zimmer; 1, 3b, 4 – Amedica; 4 – Cytonics, EndoLuxe, Nocimed, nView Medical Inc., Vital5; 7 – Journal of the American Academy of Orthopaedic Surgeons, Springer
Patel, Ankur	n
Patel, Harshadkumar A.	n
Patel, Ravi B.	n
Patel, Rikesh	n
Patel, Ronak M.	3b – Advancare Home Health, Ceterix; 4 - Edge
Pathak, Varun	n
Patt, Joshua C.	n
Patterson, Brendan M.	n

Patton, Daniel J.	3b – Bespa Global, LLC
Pawloski, Jacob	n
Pearce, Kalin R.	n
Pearl, Andrew D.	1, 3b – Zimmer; 3b – Arthrex, Inc., Stryker
Pensy, Ray A.	2, 3b – Globus Medical
Pepper, Andrew M.	n
Perez, Jorge L.	n
Perry, Kevin I.	n
Perry, Michael	n
Peters, Colleen M.	n
Petersen-Fitts, Graysen R.	n
Peterson, Eric	n
Peterson, Hamlet A.	7 - Springer
Petis, Stephen M.	n
Petrash, Carson	n
Pfeiffer, Ferris M.	n
Pharr, Zachary K.	n
Phillips, Sierra G.	n
Phisitkul, Phinit	1, 3b – Arthrex, Inc.; 4 – First Ray, Mortise Medical
Pietrini, Nicholas	n
Pinter, Zachariah	n
Pinto, Martim C.	n
Pinzur, Michael S.	2, 3b - Stryker
Piuzzi, Nicolas S.	n
Place, Howard M.	3b – DePuy, a Johnson & Johnson Company
Plumarom, Yanin	n
Poland, Sarah G.	n
Polster, Joshua	n
Ponce, Brent A.	1 – Wright Medical Technology, Inc.; 2, 3b – Tornier; 4 – Help Lightning
Post, Joel M.	n
Potter, G. David	n
Pourzal, Robin	6 - Zimmer
Pruis, Taylor	n
Pugely, Andrew J.	n
Pui, Ching-Hon	n
Puri, Sameer	n
Qin, Charles	n
Quanbeck, Deborah S.	n
Rajani, Rajiv	4 – Johnson & Johnson, Pfizer
Rambau, Genevieve M.	n
Ramo, Brandon	7 – Saunders/Mosby-Elsevier
Ransom, Erin	n
Rao, Allison J.	n
Raspovic, Katherine M.	n
Razi, Afshin	3b – Johnson & Johnson
Rebehn, Kelsey A.	n
Redmond, John M.	2 – Arthrex, Inc.
Rees, Harold W.	n
Reif, Taylor J.	n
Ren, Weiping	n
Renard, Regis L.	2 – Nuvasive; 3b – Acumed, LLC, Medtronic Sofamor Danek, Synthes; 6 – Smith & Nephew, Stryker
Rhee, Peter C.	2 - Trimed

Ricci, William M.	1 – MicroPort; 1, 3b, 5 – Smith & Nephew; 3b – Zimmer Biomet; 5 – Synthes; 6 – Cable Fix LLC, McGinley Orthopaedics, SMV Recon, LLC; 7 – Journal of Bone and Joint Surgery-American, Wolters Kluwer Health – Lippincott Williams & Wilkins
Rice, Olivia M.	n
Ridley, Taylor J.	n
Riley, Patrick M., Sr.	2 - OrthoPediatrics
Ring, David C.	1 – Skeletal Dynamics, Wright Medical Technologies, Inc.
Rixey, Allison B.	n
Rizzo, Marco	3b – Zimmer
Roberson, Troy A.	n
Robinson, David	n
Robinson, William A.	n
Roche, Martin W.	1, 2, 3b, 4 – OrthoSensor; 1, 2, 3b, 5 – MAKO-Stryker; 4 - Cayenne
Roebke, Austin J.	n
Roebke, Logan J.	n
Romeo, Anthony A.	1, 2, 3b, 5, 6 – Arthrex, Inc.; 5 – Aesculap/B.Braun, Histogenics, Medipost, NuTech, OrthoSpace, Smith & Nephew, Zimmer; 6 – AANA, MLB; 7 – Saunders/Mosby-Elsevier, SLACK
Romero, Jose A.	n
Rosas, Samuel	n
Rose, Anne J.	n
Rose, Peter S.	3b – K2M, Inc.
Rosneck, James T.	3b – Smith & Nephew
Ross, Phillip R.	n
Rothrock, Nan	5 – AO Patient Outcomes Center US, Inc.; 7 - UpToDate
Routt, Milton L., Jr.	2, AONA, Johnson & Johnson, Stryker, Ziehm, Zimmer
Rue, Loring W.	n
Sabatino, Meagan	n
Sabbag, Orlando	n
Sabesan, Vani J.	3b – Pacira; 5 – Exactech, Inc.
Sachleben, Brant C.	n
Sacksteder, Nicholas J.	n
Sadauskas, Alex J.	n
Sager, Brian W.	n
Sahranavard, Bahman	n
Saifi, Comron	4 – Gilead, Novartis, Vertera
Salata, Michael J.	3b – Smith & Nephew
Salazar, Dane H.	n
Saltzman, Matthew D.	1, 3b – Wright Medical Technology, Inc.; 3b – CareFusion, Medacta
Sambhariya, Varun	n
Sanchez-Sotelo, Joaquin	1, 2, 5 – Stryker; 2 – Acumed; 3b – Exactech, Inc.; 7 – Elsevier, Journal of Shoulder and Elbow Surgery
Sanders, Drew T.	n
Sanders, Thomas L.	n
Saris, Daniel B. F.	3b – Cartiheal, Vericel; 3b, 5 – Smith & Nephew; 5 – Arthex, Inc., Ivy Sports
Sathy, Ashoke K.	n
Saunders, Ryker	n
Savage, Alexander D.	n
Sawyer, Jeffrey R.	2 – DePuy, a Johnson & Johnson Company, Nuvasive; 7 – Mosby, Wolters Kluwer Health – Lippincott Williams & Wilkins
Schell, Benjamin A.	n

Schiff, Adam P.	3b – Regeneration Technologies, Inc., Sonoma, Stryker
Schiffen, Alison N.	n
Schlierf, Thomas	n
Schlosser, Kayla	n
Schmanke, Ken	n
Schmidt, Andrew H.	1 – Smith & Nephew; 3b – Acumed, LLC, St. Jude Medical; 3b, 4 – Conventus Orthopedics; 4 – ActivOrtho, Epion, Epix VAN; 7 – Thieme, Inc.
Schmitt, Daniel R.	n
Schoenecker, Perry L.	n
Schulz, Jacob F.	3b – NEXXT Spine
Sculco, Peter K.	n
Schumaier, Adam P.	n
Schwab, Joseph H.	2 - Stryker
Sciadini, Marcus F.	3b – Globus Medical; 3b, 4 - Stryker
Scott, Elizabeth J.	n
Scott, Richard D.	1 – Innomed; 3b, 4, 6 – Medtronic; 4 – ConforMIS, Johnson & Johnson; 7 - Springer
Scotting, Oliver	n
Seetharam, Abhi	n
Seidel, Hudson H.	4 - Pfizer
Selley, Ryan S.	n
Sembrano, Jonathan N.	5 – Nuvasive, SI-Bone, Zyga
Sems, S. Andrew	1, 3b - Zimmer
Sershon, Robert A.	n
Sever, Ronen	n
Sexton, Jimmy	n
Sexton, Kevin W.	n
Shah, Apurva S.	n
Shah, Ashish	n
Shahriar, Rajin	n
Shakir, Irshad A.	n
Shamaa, M. Tayseer	n
Shanley, Ellen	n
Shaughnessy, William M.	n
Shaw, Jonathan	n
Sheehan, Joseph	n
Shemory, Scott T.	n
Sherman, Seth L.	3b – Ceterix Orthopaedics, CONMED Linvatec, Moximed, Neotis, Regeneration Technologies, Inc., Vericel; 3b, 5 – Arthrex, Inc.; 5 - Zimmer
Sherwood, Alexandria J.	n
Shields, Rachel	n
Shin, Alexander Y.	1 – Trimed
Shrestha, Kevin S.	n
Shukla, Dave R.	n
Siebler, Justin C.	n
Siegel, Eric R.	n
Sierra, Rafael J.	1, 3b – Link Orthopaedics; 1, 5 – Zimmer; 2, 3b, 5 – Biomet; 5 – DePuy, a Johnson & Johnson Company, Stryker; 7 - Springer
Siffri, Paul C.	3a – Southern Orthopedics; 3b, 3c, 5 – Arthrex, Inc.; 5 – Arthrocare, Arthrosurface, Breg, DJ Orthopaedics, Neurotech, Pacira Pharmaceuticals, Smith & Nephew
Siljander, Matthew P.	n

Silverton, Craig D.	1 - Biomet
Sim, Franklin H.	7 – Saunders/Mosby-Elsevier
Singh, Partik	n
Sinha, Preetha	n
Sipahi, Remzi K.	n
Siqueira, Marcelo B. P.	n
Skie, Martin C.	n
Slotkin, Steven R.	n
Smigielski, Daniel	n
Smith, Langan	n
Smith, Matthew J.	1, 3b – Zimmer; 2, 3b, 5 – Arthrex, Inc.; 5 - Tornier
Smith, Richard A.	n
Smith, Walter R.	n
Sobh, Ali H.	n
Sochacki, Kyle	n
Sodhi, Nipun	n
Soufan, Kassem	n
Southam, Brendan R.	5 – DePuy, a Johnson & Johnson Company
Sperling, John W.	1 – Biomet, DJ Orthopaedics; 1, 3b – Wright Medical Technology, Inc.; 3b – Exactech, Inc., Zimmer; 4 - RA
Spinner, Robert J.	3b – Mayo Medical Ventures; 7 – Saunders/Mosby-Elsevier
Sporer, Scott M.	1, 3b – DJO Surgical, Osteoremedies; 1, 5 – Zimmer; 3b, 4 – Myoscience; 5 – Stryker; 7 – SLACK Incorporated
Spraggs-Hughes, Amanda	n
Srinath, Arjun	n
Srivastava, Karan	n
Staggers, Jackson	n
Stambough, Jeffrey B.	n
Stannard, James P.	3b – Acelity, DePuy, a Johnson & Johnson Company, Nuvasive, Smith & Nephew; 3b, 5 – Arthrex, Inc.; 5 – Coulter Foundation, U.S. Department of Defense; 7 - Thieme
Stans, Anthony A.	n
Starnes, Austin	n
Starr, Adam J.	1 – Starrframe, LLC; 2 – Smith & Nephew
Stearns, Kim L.	2 - Fidiapharma
Steen, R. Grant	3a – Smith & Nephew
Stephens, Jeffrey P.	n
Stephens, Raj	n
Stevens, Wilshaw R.	n
Stirton, Jacob B.	n
Stokes, Derek C.	n
Stover, Michael D.	2 – AO Foundation; 3b – DePuy, a Johnson & Johnson Company; 4 - Radlink
Strotman, Patrick K.	n
Stuart, Michael J.	1, 3b – Arthrex, Inc.; 5 - Stryker
Stubbart, James R.	n
Stubbs, Trevor	n
Sullivan, Ryan	n
Sultan, Assem	n
Surma, Tyler	n
Swank, Katherine	n
Sweet, Matthew C.	n

Swiontkowski, Marc F.	6 – U.S. Department of Defense – Chair METRC DSMB, USDOD; 7 – Journal of Bone and Joint Surgery-American, Saunders/Mosby-Elsevier, Wolters Kluwer Health - Lippincott Williams & Wilkins
Tait, Mark A.	n
Taliaferro, Kevin	n
Tan, Dean D.	n
Tan, Timothy L.	n
Tanenbaum, Joseph E.	n
Tantavisut, Saran	n
Taunton, Michael J	1, 3b – DJ Orthopaedics; 5 – DePuy, a Johnson & Johnson Company, Stryker
Taylor, Kevin	n
Tecle, Nahom	n
Telford, Clara L.	n
Templeman, David C.	1 – Zimmer; 2, 3b – Stryker; 3b – Orthofix, Inc., 4 - Naroflex
Tenbrunsel, Troy T.	n
Terhoeve, Cristina M.	n
Tetreault, Matthew W.	n
Thankam, Finosh G.	n
Thigpen, Charles	4 – Players Health, Trex; 5 – Arthrex, Inc., Neurotech-Kneehab
Thomas, Dimitri M.	n
Thomas, Holly	n
Throckmorton, Thomas W.	1, 2 – Zimmer; 1, 2, 3b, 5 – Biomet; 3b – Pacira; 4 – Gilead; 7 – Saunders/Mosby-Elsevier
Tibbo, Meagan E.	n
Tibone, James E.	3c – Arthrex, Inc.
Tofte, Josef N.	n
Tokish, John M.	2, 3b – Arthrex, Inc.; 3b – DePuy, a Johnson & Johnson Company, Mitek
Tolan, Stefan	3b – Stryker
Toy, Patrick C.	1 – Innomed; 3b – Biomet, Medtronic, Smith & Nephew
Trafton, Hunter	n
Tramer, Joseph S.	n
Trembath, Hannah E.	n
Trent, Jesse J.	n
Triplet, Jacob J.	n
Tripod, Morgan E.	n
Troester, Alexander M.	n
Trousdale, Robert A.	1 – Medtronic; 1, 3b – DePuy, a Johnson & Johnson Company
Tu, Leigh-Anne	n
Tuinstra, Daniel M.	n
Turner, Norman S.	n
Twomey, Kristin D.	n
Ussef, Najib	n
Vakharia, Rush	n
Vaidya, Anshul	n
Vaidya, Rahul	3b – Stryker; 5 - Pfizer
van der List, Jelle P.	n
van Holsbeeck, Marnix	4 – Bristol-Myers Squibb, Johnson & Johnson, Norvartis; 4, 5 – GE Healthcare; 5 – Siemens Healthcare; 7 – Jaypee Brothers, MedEd 3D
Vander Voort, Wyatt D.	n

VanPelt, Michael	n
Varadarjan, Kaushik	n
Vasileff, William K.	n
Vaux, Jonathan	n
Verma, Nikhil N.	1, 3b – Smith & Nephew; 3b – Orthospace; 3b, 4 – Minivasive; 4 – Cymedica, Omeros; 5 – Arthrex, Inc., ArthroSurface, Athletico, ConMed Linvatec, DJ Orthopaedics, Miomed, Mitek, Ossur, Smith & Nephew; 7 – Vindico Medical-Orthopedics Hyperguide
Verner, James J.	n
Visperas, Anabelle	n
Visscher, Sue L.	n
Vite, Lorenzo	n
Voekl, Chelsea E.	n
Voos, James E.	3b – Arthrex, Inc.
Vopat, Matthew L.	n
Voss, Elliott E.	n
Wagner, Eric R.	n
Wagstrum, Emily	n
Walsh, Christopher P.	n
Walters, Jordan	n
Wang, Dean	n
Wanderman, Nathan R.	n
Warth, Lucian C.	3b – Link Orthopaedics
Washington, Travis C.	n
Watson, J. Tracy	1 – Biomet, Advanced Orthopaedic Solutions; 1, 2 – Smith & Nephew; 2 – Zimmer; 2, 3b – Nuvasive; 3b – Acumed, LLC, Bioventus
Watson, Shawna L.	n
Weiner, Dennis S.	n
Weiner, Scott D.	n
Weisenburger, Joel N.	n
West, Christopher	n
Westberg, Jerald R.	n
Westerlind, Brian O.	n
Westermann, Robert W.	n
Wetzel, Robert J.	1 - Innomed
Whaley, James D.	n
White, Melissa S.	n
Whitfield, James	n
Whitlock, Keith G.	n
Wiater, Patrick J.	3b, 5 – Arthrex, Inc.
Wilder, Kerry	n
Wiley, Marcel R.	n
Wilkinson, Brandon G.	n
Willey, Michael C.	5 - Biomet
Williams, Johnathan F.	n
Williams, Nick	n
Williams, Sarah	n
Wills, Bradley W.	n
Wilson, Philip L.	5 – Allosource, Ossur; 7 - Elsevier
Wolf, Brian R.	3b – CONMED Linvatec; 5 – OREF; 6 – Arthrex, Inc., Smith & Nephew
Woods, David P.	n
Worley, John R.	n
Worthen, James V.	n
Wortman, Katy	n

Wu, Huiyun	n
Wu, Isabella T.	n
Wu, Jianrong	n
Wukich, Dane K.	1 – Arthrex, Inc.
Wunder, Jay S.	n
Wyles, Cody C.	n
Wyrick, John D.	2 – Smith & Nephew; 3b - Stryker
Wyrick, Theresa O.	n
Yahuaca, Bernardo I.	n
Yakubek, George A.	n
Yang, Shang-You	n
Yanik, John M.	n
Yao, Dong-han	n
Yaszemski, Michael J.	3b – K2M, Inc., Medtronic
Yetter, Thomas R.	n
Yokhana, Sanar S.	n
Yoon, Patrick	2, 3b – Paragon 28
Yson, Sharon C.	n
Yu, Charles C.	n
Yuan, Brandon J.	n
Zaltz, Ira	3b - Orthopediatrics
Zebala, Lukas P.	2 – Broadwater LLC; 2, 3b – Medtronic; 3b – K2M, 5 – Pacira Pharmaceuticals
Zhang, Liying	n
Zhang, Ting	n
Ziemba-Davis, Mary	n
Zura, Robert D.	2, 3b – Bioventus, Smith & Nephew