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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 14, 2016

Liposomal Bupivacaine vs. Femoral Nerve Block in Managing Pain After Anterior Cruciate Ligament Reconstruction

Abstract ID: Paper 001

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INTRODUCTION: Adequate postoperative pain management following arthroscopic anterior cruciate ligament (ACL) reconstruction is essential to hasten rehabilitation and improve patient satisfaction. Currently, the gold standard for pain management after knee surgery is femoral nerve block (FNB); however, recent trials have demonstrated reasonable postoperative pain control with locally infiltrated Liposomal Bupivacaine. No clinical studies have examined the effectiveness of Liposomal Bupivacaine at pain control following ACL reconstructions. The aim of this study was to compare the effectiveness of Liposomal Bupivacaine to FNB in controlling post-ACL reconstruction pain.

METHODS: This study was a prospective, randomized clinical trial. One hundred patients surgically treated for primary ACL tears were consented for participation. Patients were randomized to receive either intraoperative local infiltration of Liposomal Bupivacaine (20 cc Bupivacaine/10 cc saline) using a standardized injection protocol or preoperative FNB. Following surgery, patient's pain and opioid consumption was recorded using a Visual Analog Scale (VAS) and IV morphine equivalents for four days. The primary outcome of interest was postoperative pain levels. Secondary outcomes assessed include opioid consumption, hours slept, and patient satisfaction with pain management.

RESULTS: A total of 100 patients were evaluated; 50 were given a preoperative FNB and 50 were treated with local Liposomal Bupivacaine infiltration. Outcomes showed no significant

difference between average pain levels in the two groups on postoperative day (POD) 0; mean 5.6 vs. 5.6 (p=0.99), POD 1; mean 4.9 vs. 5.2 (p= 0.65), and POD 2; mean 3.9 vs. 4.2 (p=0.67). No differences were found in average IV morphine equivalents used between the two groups on POD 0, 1, and 2 (p= 0.12, 0.48, 0.74). Patients receiving Liposomal Bupivacaine reported a statistically significant greater number of hours slept on POD 0, 1, and 3 (P= 0.031, 0.007, 0.041). There was also a non-significant perception of greater satisfaction with pain management in the Liposomal Bupivacaine group on POD 0,1 and 2 (67% vs. 57%, 80% vs. 56%, 94% vs. 65%).

CONCLUSION: No significant difference was seen when comparing Liposomal Bupivacaine to FNB for control of post-ACL reconstruction pain. Additionally, there was no significant difference in opioid consumption postoperatively. However, patients in the Liposomal Bupivacaine group reported a greater number of hours slept and a non-significant increase in satisfaction with their pain management. These results suggest that Liposomal Bupivacaine is at least as effective as FNB in ACL reconstruction patients and can be used as a primary method to manage pain control post-ACL reconstruction.

Administration of Oral Antibiotics Following Two-Stage Exchange for Periprosthetic Joint Infection Reduces Subsequent Failure: A Multi-Center, Randomized Controlled Trial

Abstract ID: Paper 002

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INTRODUCTION: A substantial number of patients develop recurrent periprosthetic joint infection (PJI) following two-stage exchange arthroplasty. The purpose of this multicenter randomized controlled trial was to determine if three months of oral antibiotics would decrease the risk of failure following a two-stage exchange.

METHODS: We invited all members of the Knee Society to participate in the trial. Following Institutional Review Board approval, seven centers enrolled patients who were randomized to receive three months of oral antibiotics or no further antibiotic treatment after operative cultures following the second stage reimplantation were negative. Oral antibiotic therapy was tailored to the original infecting organism(s) in consultation with an Infectious Disease specialist. A priori power analysis determined that 77 patients per group would be required to demonstrate a reduction in infection recurrence from 16% to 4% (β=0.80 and α=0.05). A log rank survival curve was used to analyze the primary outcome of reinfection.

RESULTS: 53 patients were randomized to the antibiotic group and 41 in the control group; 14 were excluded for protocol deviations (most commonly discontinuation of antibiotics prior to 90 days) leaving 40 patients in each group with a mean follow-up of 16.3 months in the antibiotic and 11.4 months in the control group. PJI followed a TKA in 41 patients and a THA in 39. Mean age, BMI, sex distribution, and Charlson index were similar amongst the groups suggesting appropriate randomization. There have been two failures in the antibiotic group compared to eight amongst controls (5% vs. 20%; p=0.0232 using log rank survival curve analysis). Seven of the 8 failures in the control group were with new organisms and both failures in the antibiotic group were with the same organism.

CONCLUSIONS: This multicenter randomized trial suggests that at short-term follow-up, the addition of three months of oral antibiotics significantly improved infection-free survival.

Improvement of Pedicle Screw Placement With First-Time Use of Patient Specific Drill Guides by Novice Surgeon

Abstract ID: Paper 003

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INTRODUCTION: Accurate placement of pedicle screws is a key component spine surgery, but allows small margin of error. Misplacement can result in paralysis or a major bleed. Current methods require the surgeon to place the screw blindly and/or at with the aid of expensive equipment that typically exposes the patient to radiation. Some studies have been performed to validate the use of 3D-printed, patient-specific instrumentation (PSI), but none to date have compared their efficacy over freehand (FH) placement. Also, no studies have measured PSI effectiveness when used by a novice surgeon.

METHODS: A CT scan of a cadaveric spine was obtained and 3D reconstructed. Trajectories for screw placement were planned for T1-L5 vertebral levels. A PSI was created in CAD software around said trajectories. One pedicle was randomized to the PSI group at each vertebra with the opposite pedicle serving as the control for the FH group. A junior orthopedic resident using a PSI, 3 mm drill, and standard instrumentation placed all 17 PSI grouped pedicles. A scan was performed and the screws were removed. Three days later the surgeon returned to the spine and repeated the steps using only FH instrumentation. All placements were timed. No fluoroscopy or adjustments from initial placement were allowed in either grouping. Postoperative reconstruction of each scan was analyzed by a staff surgeon for perforation, adequacy of placement, and likelihood of unfavorable outcome. The PSI grouping was also analyzed for deviation from plan.

RESULTS: There were three perforations in the PSI group as opposed to eight in the FH grouping (p-value 0.1411). Only one of the PSI screws was designated as needing to be adjusted compared to six of the FH screws (p-value=0.0854). Five of the FH screws were deemed to likely or definitely result in paralysis vs. zero in the PSI grouping (p-value 0.0445). The surgeon had a mean PSI placement time 47.9 second faster than the FH placement time (145.2±74.4 vs. 193.1±43.0 seconds; p-value 0.0319). The PSI trajectories were accurate within 3 mm and within 9.5° from the planned trajectories (p-value 0.0213; p-value 0.0287).

CONCUSIONS: Our study was limited by a small sample size and by lack of control of screw placement after pilot hole creation. Regardless, the PSI seems to offer a relatively cheap, user friendly, and sufficiently accurate solution to pedicle screw placement in even a novice surgeon.

MAOA BREAKOUT SESSION #1
HAND/ELBOW
April 14, 2016

Metacarpophalangeal Arthroplasty for Osteoarthritis: An Implant Comparison Analysis

Abstract ID: Paper 005

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PURPOSE: The objective of this study was to assess the results MCP arthroplasty in patients with OA, comparing the functional and radiographic outcomes of 3 different types of implants.

METHODS: We performed an analysis of 60 MCP arthroplasties in 59 patients for osteoarthritis at our institution from 1998 to 2012. The mean age at surgery was 62 years, BMI 30, with 63% involving the dominant extremity. 45% of patients were female, 9% were smokers, 8% were laborers, and 10% had diabetes mellitus (DM). There were 48 non-constrained implants (38 pyrocarbon and 10 surface-replacing arthroplasties (SRAs) and 12 constrained silicone implants. Patient characteristics were similar between the pyrocarbon, SRA, and silicone groups, including age (62, 61, 65), number of females (66%, 60%, 67%), smokers (9%, 0%, 14%), and those with DM (10%, 0%, 16%).

RESULTS: There were 5 revision surgeries performed at a mean 2.1 years postoperatively. Etiologies included for revision surgery included pain with limited motion (3) and dislocation (2). The 2-, 5-, and 10-year survival rates were 91%, 88%, and 88%, respectively. The 5-year survival rates for the pyrocarbon, SRA, and silicone implants were 87%, 73%, and 100% ($p=0.14$), respectively. Patients that had a SRA implant had a slightly increased risk of implant failure (HR 4.22, $p=0.1$), as did younger age and need for bone graft. There was one intraoperative complication involving a periprosthetic fracture, while postoperative complications included 2 dislocations, 1 heterotopic ossification, and 1 infection. There were no significant differences in the rate of complications between the implants. In those unrevised patients, at a mean 5 years (2-10) follow-up, preoperative to postoperative pain levels significantly improved ($p<0.01$). MCP total arc of motion did not significantly improve from 47° preoperatively to 54° postoperatively ($p=0.67$), while there was no significant change in grip or pinch strength. Total arc of motion was decreased in the silicone group (39°), compared to the SRA (50°) and pyrocarbon (60°) ($p=0.01$), but there was no difference in grip or pinch strength.

SUMMARY POINTS: MCP arthroplasty for osteoarthritis is a successful procedure with good medium-term survival and low complications. There was a slightly increased risk of revision surgery with SRA implants, but no significant difference between pyrocarbon and silicone. Patients experience predictable pain relief and maintenance of their motion. MCP arthroplasty provides a very promising motion-sparing option in its definitive management.

Obesity Increases Complexity of Distal Radius Fracture in Fall from Standing Height

Abstract ID: Paper 006

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INTRODUCTION: Both obesity and fractures of the distal radius are epidemic conditions in the United States. The relationship between these two conditions has not been previously investigated. Our purpose was to investigate the relationship between body mass index (BMI) and distal radius fracture severity following low-energy trauma resulting from a fall from standing height. We further aimed to identify patient-specific, independent risk factors predictive of increasing distal radius fracture severity.

METHODS: A retrospective chart review of 423 adult subjects with a history of fracture of the distal radius resulting from a fall from standing height was completed. Demographic data and injury characteristics were obtained including age at time of injury, gender, ethnicity, weight, BMI, tobacco use, personal history of diabetes, mechanism of injury, open fracture, and presence of ipsilateral upper extremity fracture. Preoperative wrist radiographs were reviewed and classified by the AO/OTA classification system. Distal radius fractures were categorized at simple (closed, extra-articular [AO/OTA 23-A] without associated ipsilateral upper extremity fracture) or complex (intra-articular [AO/OTA 23-B or 23-C] or open fracture or concomitant ipsilateral upper extremity fracture). Multivariate logistic regression was completed to model the probability of incurring a complex fracture.

RESULTS: Average age at the time of injury was 53.8 years (range 18.9-98.4). 79% of subjects were female. The average BMI was 28.1 (range 13.6-59.5). 244 patients (58%) suffered complex distal radius fractures per study criteria. Obese patients (BMI >30) demonstrated increased fracture severity per the AO/OTA classification ($p=0.039$) and were more likely to suffer a complex injury ($p=0.032$). Multivariate regression identified male gender, obesity, and age ≥50 as independent risk factors for sustaining a complex fracture pattern. The probability of complex fracture ranged from 38% (female, age 18-50, BMI 19) to 88% (male, age >50, BMI 52) according to the regression model.

CONCLUSIONS: Obesity is associated with more complex fractures of the distal radius following low-energy trauma, particularly in elderly patients. This relationship has not been previously reported and may have important epidemiologic and societal implications in an obese, aging population.

Clinical and Radiographic Outcomes of Simultaneous Unilateral Basal Joint Arthroplasty and Scaphoidectomy With Four-Corner Fusion

Abstract ID: Paper 007

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INTRODUCTION: Basal joint arthritis of the thumb and wrist arthritis are frequently treated with surgical intervention upon failure of conservative management. Not infrequently, patients will present with coexisting, symptomatic basal joint and wrist arthritis requiring surgical intervention. There is no current standard of care for these patients. It has become our practice to offer basal joint arthroplasty in the form of ligament reconstruction and tendon interposition (LRTI) along with scaphoidectomy and four-corner fusion at a single surgical intervention.

METHODS: A retrospective case series was performed of patients who underwent simultaneous LRTI and scaphoidectomy with four-corner fusion for advanced basal joint and wrist arthritis, respectively. Preoperative and postoperative visual analog scale (VAS) pain scores, postoperative active wrist flexion and extension, time to radiographic fusion, and first metacarpal subsidence (referenced from second metacarpal-trapezoid joint) were recorded.

RESULTS: Six patients and a total of 7 wrists were identified. The average age at time of surgery was 67 years (51-81). There were 4 males, 2 females. Four out of 7 operative wrists were in the dominant extremity. The average operative time was 169 minutes (90-230). A 1-2 metacarpal pin was placed in 4 of 7 wrists according to surgeon preference. The average follow-up was 12 months (3-64). Average time to radiographic fusion of midcarpal arthrodesis was 15.6 weeks (9-34). VAS scores decreased from an average of 8.3 (5-10) to 3.3 (0-8). Average postoperative flexion and extension were 37.6° (10-50) and 34.9° (10-45), respectively. Postoperative first metacarpal subsidence was an average of 6.3 mm (3.9-10.9). No patients noted functional impairment from metacarpal height loss. Complications were a result of the arthrodesis hardware: 2 patients underwent loose screw removal; and another had the plate removed due to extensor tenosynovitis.

CONCLUSION: Simultaneous unilateral basal joint arthroplasty and scaphoidectomy may be performed safely in a single operative setting in the context of concomitant wrist and thumb arthritis. Patient outcomes demonstrate decreased pain with preserved wrist motion and metacarpal height. When compared to the historic studies, first metacarpal subsidence in these patients is similar to that of patients who undergo LRTI alone, despite the absence of the scaphoid.

Buying Time: Long-Term Results of Wrist Denervation and Time to Repeat Surgery

Abstract ID: Paper 008

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HYPOTHESIS: Wrist denervation has been shown to be a good option for patients with chronic wrist pain related to articular degeneration or chronic instability. Removal of the sensory innervation to the wrist joint provides relief of pain; however, denervation does not address the underlying pathology. Patients continue to undergo degenerative changes and may need revision procedures. This study reviews the 20-year long-term outcomes of patients treated with partial wrist (anterior and posterior interosseous nerve) denervation focusing on need for and time to salvage procedure.

METHODS: We conducted an IRB approved retrospective study over a 20-year period of all patients undergoing wrist denervation by the lead authors between 1994 and 2014. At latest follow-up, data including range of motion, grip strength, radiographic degeneration, and need for revision surgery were recorded.

RESULTS: The series includes 106 patients (68 male, 38 female) with an average age at surgery of 52 (range 14 to 80). Average follow-up was 78 months (range 3 to 212). The main diagnoses in this series were SLAC degenerative arthritis (43%) and radiocarpal arthritis (40%). Average flexion to extension arc was 93° on the affected extremity (76% of the contralateral) and average grip strength was 83% of unaffected extremity.

Seventy one percent of patients (75/106) had satisfactory outcomes and did not require revision procedures at average follow-up of 78 months (range 3 to 212). Twenty-nine percent (31/106) of patients underwent revision surgery including four corner fusion (11), total wrist fusion (6), proximal row carpectomy (4), radioscapholunate fusion (3), total wrist arthroplasty (1), Sauve-Kapandji (1), ulnar shortening procedure (1), Darrach (1), radial styloidectomy (1) and ulnar head hemiresection interposition arthroplasty (1). Time to salvage surgery was on average 25 months after denervation (range 2 to 165).

SUMMARY POINTS:
• Partial wrist denervation is a reliable motion preserving procedure for patients with chronic wrist pain. In this series, 71% of patients experienced pain relief and did not require further salvage procedures at an average of 78 months of follow-up.
• Twenty-nine percent of patients ultimately underwent salvage procedure. On average, the patients experienced pain relief for 25 months (range 2 to 165) prior to ultimately undergoing a salvage operation.
• The significance of these results better enable surgeons to give time estimates and expectations regarding pain control following wrist denervation in the patient with chronic wrist pain.

The Arkansas Hand Trauma Telemedicine System: A Review of the First Year

Abstract ID: Paper 009

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INTRODUCTION: The Arkansas Hand Trauma Telemedicine System works to coordinate care of traumatic hand injuries. The system utilizes telemedicine equipment in Emergency Rooms and tablet computers provided to the on call hand surgeon for video evaluation and recommendations. We hypothesized that utilization of the telemedicine system would result in an alteration of disposition patterns favoring local and general orthopedic care which would result in faster disposition and shorter distances for travel when a transfer is required. Additionally, the system would demonstrate efficiency in after hours disposition.

METHODS: Data was collected from the Arkansas Trauma Communication Center database from the first year of implementation (January 1, 2014- December 31, 2014) including type of telemedicine, need for and type of transfer, time to disposition, and distance for transfer. Statistical analysis utilized the Student T-Test.

RESULTS: In 2014, there were 331 hand traumas of which 298 received telemedicine consults (90%). Of these patients, 195 (65%) received live video consults while 103 (35%) were telephone only. After telemedicine consult, 164 (55%) patients were appropriate for local care while 134 (45%) required transfer to another facility for hand specialist (72 patients) or general orthopedic (62 patients) care. Patients being transferred for general orthopedic care traveled 60.21 miles on average while patients transferred for an in-state hand specialist traveled 92.18 which was significant (p=0.0001). The time from contacting the ATCC to acceptance of the patient for general orthopedic care averaged 48.58 minutes, while patients disposition to an in-state hand specialist averaged 38.90. This was a significant difference (p=0.02). After hours transfers for a hand specialist averaged 37.11 minutes and during business hours 41.09 which was not significant (p=0.25). Transfers for general orthopedic care after hours averaged 46.71 minutes and during business hours 51.12 which was not significant (p=0.267).

SUMMARY:
●Patients requiring general orthopedic care traveled shorter distances and received faster care by utilizing resources in proximity with less cost to the patient and the system.
●Time to disposition for transfer was more efficient for patients requiring a hand specialist. This may reflect the severity of the injury as well as reduced options for acceptance.
●Hand injuries requiring consultation and transfer are taken care of equally efficient at all hours for both hand specialists and general orthopedics.
●This data shows the clinical and likely financial impact of a telemedicine system for hand trauma, especially for a largely rural state with limited resources.

Comparison of 2-D and 3-D Metacarpal Fracture Plating Constructs Under Cyclic Loading

Abstract ID: Paper 010

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PURPOSE: To determine if any differences in fixation construct stability exists under cyclic loading and subsequent load-to-failure between locking double-row (3D) plates and single-row (2D) plates in a metacarpal sawbone fracture gap model simulating mid-diaphyseal comminution.

HYPOTHESIS: 1.5-mm Synthes locking 3D plates will demonstrate equal or greater stability under cyclic loading in comparison to 2.0 mm Synthes locking 2D plates in a sawbone model simulating an aggressive range of motion postoperative protocol. Furthermore, we predict the 3D plates will demonstrate a higher tensile strength when loaded to failure.

METHODS: Thirty metacarpal saw bones were cut with a 1.75 mm gap in between the two pieces simulating a comminuted fracture pattern. Half of the bones were plated with 2D plates and half with 3D plates. The plated bones were then mounted into a Materials Testing System (MTS) Mini Bionix testing apparatus where they were cyclically loaded under cantilever bending for 2,000 cycles at 70N, 2,000 cycles at 120N, and then monotonically loaded to failure. Throughout the testing sequence, fracture gap sizes were measured, failure modes were recorded, and construct strengths and stiffnesses were calculated for comparison.

RESULTS: All double-row constructs survived both cyclic loading conditions. Ten of the 15 (67%) single-row constructs survived both cyclic loading conditions, while five constructs failed during the 120N loading at 1377 +/- 363 cycles. When loaded to failure, the double-row constructs failed at 265 N +/- 21 N, whereas the single-row constructs surviving cyclic loading failed at 190 N +/- 17 N ($p < 0.001$). The double-row plates exhibited significantly lower stiffness ($p<0.001$); however, the construct stiffness was not significantly different.

CONCLUSION: Double-row metacarpal plates offer a lower profile metacarpal fixation option that provides the stability necessary for an early postoperative range of motion protocol. Double-row plates demonstrated increased resistance to failure in a cyclic loading model and increased load to failure compared to higher profile single-row metacarpal plates.

Proximal Row Carpectomy and Four-Corner Fusion in Patients Under 45 Years Old

Abstract ID: Paper 011

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PURPOSE: The purpose of this study was to examine the long-term survival-free of fusion, complications, and extremity function in patients under 45 who underwent either PRC or 4CF.

METHODS: Review of 91 patients who underwent either 4CF (n=49) or PRC (n=42) under the age of 45 years from 1972 to 2008 for the diagnosis of wrist arthritis. Comparing 4CF and PRC groups, there was similar mean age (34 vs. 32), but fewer laborers (47% vs. 59%) and more males (92% vs. 57%) in the 4CF than the PRC group. A similar percentage of patients in 4CF and PRC groups underwent AIN and/or PIN (35% vs. 29%, p=0.72).

RESULTS: The mean follow-up was 15 years (2-41), including 12 years in the 4CF group and 18 years in the PRC group. There were 11 wrists that required revision to radiocarpal fusion (4 in 4CF and 7 in PRC group). Additional reoperations in the 4CF group included 4 revision 4CF for nonunion, 4 surgeries for impingement, while in the PRC group 1 patient was converted to a wrist arthroplasty, 1 ulnar head replacement, and 1 irrigation and debridement. The 10- and 20-year survival free of fusion rates for the 4CF and PRC were 92% and 88% vs. 98% and 90%, respectively. The 10- and 20-year survival free of any revision surgery for the 4CF and PRC were 92% and 88% vs. 98% and 90%, respectively (p=0.42). Complications included 4 (8%) nonunions in the 4CF group, 1 infection in each group, and 9 patients experiencing impingement (6 4CF and 3 PRC). There was no difference in the number of patients reporting moderate or severe pain between PRC and 4CF groups (p=0.19). The mean flexion-extension arc was 53° after 4CF compared to 69° underwent 4CF had slightly improved grip strength (65% of opposite side) compared to PRC (53%) (p=0.07). The mean postoperative DASH scores were 30 vs. 20 (PRC vs. 4CF) (p<0.001) and PRWE scores were 26 vs. 30 (PRC vs 4CF) (p=0.20). Comparing radiographic arthritis, 63% of the PRC and 44% of the 4CF had signs of arthritis, including 40% PRC and 30% 4CF having moderate/severe arthritis (p=0.06).

SUMMARY POINTS: Both 4CF and PRC represent a good surgical option for young patients with wrist arthritis, with similar survival-free of fusion, complication rates, pain levels, and wrist function. PRC has improved motion, but higher rates of radiocarpal arthritis.

A Biomechanical Comparison of Suture-Button Suspensionplasty and LRTI for Basilar Thumb Arthritis

Abstract ID: Paper 012

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PURPOSE: To compare the initial biomechanical strength of trapeziectomy and suture-button (SB) suspensionplasty to ligament reconstruction and tendon interposition (LRTI) for thumb CMC arthritis in a cadaveric model.

METHODS: We used eight matched pairs of below-elbow cadaveric arms for this study. Each specimen was randomly assigned to either receive a trapeziectomy and LRTI (LRTI Group) or trapeziectomy and SB suspensionplasty (SB Group). Using previously described and validated testing protocols; physiological key pinch was simulated. We then incrementally loaded only the thumb metacarpal from 5 to 20 pounds, using 5-pound increments. Metacarpal subsidence during physiological key pinch and incremental loading was determined using radiographic measurements of trapezial height.

RESULTS: The pre-testing trapezial height did not differ significantly between the SB (11.9 mm) or LRTI group (13.7 mm, $p=0.4$). After simulated physiological key pinch, the SB group had significantly greater trapezial height compared to the LRTI group (8.0 mm vs. 5.5 mm, $p <0.05$). For each incremental metacarpal load from 5 to 20 pounds, the SB group had significantly greater trapezial height than the LRTI group.

CONCLUSIONS: In a cadaveric model, SB suspensionplasty is biomechanically superior in resisting metacarpal subsidence than LRTI.

CLINICAL RELEVANCE: In the treatment of basilar thumb arthritis, suture-button suspensionplasty provides a strong alternative to LRTI without the need for tendon harvest.

Elbow Arthroscopy for the Treatment of Rheumatoid Arthritis: Functional Outcomes and Complications

Abstract ID: Paper 013

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INTRODUCTION: 50% of patients with rheumatoid arthritis have symptoms involving the elbows. Previous studies with small patient numbers have shown favorable results with both open and arthroscopic synovectomy for the treatment of early (Larsen grade 1 or 2) rheumatoid arthritis of the elbow. The purpose of this study was to look at the functional outcome of arthroscopic synovectomy of the elbow in a large patient cohort and analyze the complication rate and need for secondary surgeries.

MATERIALS AND METHODS: From 1999-2009, all patients who underwent elbow arthroscopy at our institution for the treatment of rheumatoid arthritis were identified from the surgical database. Patients who had undergone previous surgical intervention were excluded leaving 57 elbows (56 patients) age 18 or greater who had undergone arthroscopic synovectomy and capsulectomy for the treatment of rheumatoid arthritis. The mean age was 50 years old (range 25-81) and patients were followed for a mean of 1 year (range 0.1-9 years). 12 patients underwent concurrent open ulnar nerve decompression. Mean tourniquet time was 85 ± 25 minutes. Outcome measurements included range of motion, need for repeat surgery, and postoperative complication rate.

RESULTS: Range of motion improved across all metrics. Mean ROM improvement was 29° ± 21°. Flexion improved from 124° to 132° and extension improved from 35° to 15° ($p<0.0001$). Pronation improved from 65° to 73° ($p= 0.0003$) and supination improved from 61° to 66° ($p=0.02$). 24 elbows (42%) suffered a surgical complication. 5 elbows suffered a major complication (2 permanent nerve injuries, 2 elbows lost > 30° of motion, 1 deep joint infection) and 15 patients suffered a minor complication (including 6 transient nerve palsies and 3 superficial infections). 15 elbows underwent repeat surgery to address continued functional limitations at a mean of 39 months with 7 elbows undergoing repeat surgery in the first 24 months. There were 4 nerve decompressions, 4 revision arthroscopic synovectomies, 4 total elbow arthroplasties at a mean of 31 months, 2 radial head excisions, and 1 patient had a cyst decompression.

CONCLUSIONS: This is the largest study looking at elbow arthroscopy for the treatment of rheumatoid arthritis. Although there are consistent improvements in range of motion and function, there are high complication rates with greater than 40% of patients suffering a complication including permanent and transient nerve injuries. Ultimately, 33% of patients will also require repeat surgery to address continued functional limitations.

Predicting Failure and Complications in TWA: Review of a 40-Year Experience

Abstract ID: Paper 014

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PURPOSE: The objective of this study was to assess the results of our institution's 40 years of experience with primary total wrist arthroplasty, identifying factors associated with failures and complications.

METHODS: We performed an analysis of 425 total wrist arthroplasties with a minimum of 2-year follow-up over a 40-year period performed at our institution from 1974 to 2013. The mean age at surgery was 57 years, BMI 27, and 72% of patients were female. The average OR time was 185 minutes, while the average tourniquet time was 132 minutes. Surgical diagnoses included 22 (5%), osteoarthritis (OA), 375 inflammatory arthritis (88%), and 86 (7%) post-traumatic arthritis (PTA). There were 8 patients with a history of traumatic wrist instability. The implants in this study included Remotions (n=31), Biax (n=159), Volz (n=33), Meuli (n=138), Universal (n=7), and Swanson (n=57). Cement was used in 357 (84%), while 36 (8%) required augmentation with bone graft.

RESULTS: At a mean follow-up of 11 years (2-35), there were 110 (26%) revision surgeries performed at a mean 5.3 years postoperatively, while there was an additional 37 reoperations. Etiologies contributing to revision surgery include loosening (n=45), component fracture (n=11), infection (n=9), wrist instability (n=31), and other (n=26). The 5-, 10-, and 20-year survival rates were 84%, 74%, and 63%, respectively. The 10-year survival rates for the inflammatory arthritis (blue) and OA or PT (red) were 76% and 63% (p=0.06), respectively. The Remotion (HR 1.84, p=0.16), Meuli (HR 1.5, p=0.04), and Universal (HR 2.90, p=0.12) had slightly increased risks of revision surgery (Table 1). Patients with inflammatory arthritis had a slightly decreased risk of revision surgery (HR 0.63, p=0.10). There were 9 (2%) intraoperative complications involving a periprosthetic fracture, while postoperative complications included implant loosening (n=51), dislocations (n=46), recurrent subluxation (n=21), heterotopic ossification (n=7), deep infection (n=12), tendon/ligament injury (n=18), and wear (n=17). Of the 51 components with loosening, 46 had distal implant loosening. Dislocation rates were higher in the Meuli implants (p=0.03), while lower with the Swanson (p<0.01), and Remotion (p=0.01). Loosening rates were higher in older patients, as well as those receiving the Biax implant (p<0.01), but were lower in the Swanson and Remotion implants (p<0.02).

SUMMARY POINTS: This series demonstrates a 74% 10-year and 63% 20-year implant survival after total wrist arthroplasty. Improved outcomes are seen in patients with inflammatory arthritis, while worse outcomes were associated with the Meuli, Universal, and Biax implants.

Assessment of Postoperative Pain and Narcotic Usage by Automated Mobile Phone Software: A Pilot Study

Abstract ID: Paper 015

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INTRODUCTION: Knowledge of postoperative pain and narcotic use after common orthopedic procedures is lacking and we recognize that understanding in these areas would be valuable in patient counseling and appropriate prescription of pain medications. Computer software algorithms allow for the automated delivery of predefined questions and reminders to patients via text messages and mobile phone technology. Inquiry into how healthcare systems can communicate with patients outside of the hospital setting may improve care while decreasing cost and utilization of healthcare resources. This pilot investigation aimed to determine the feasibility of obtaining patient-reported data on pain and narcotic usage following ambulatory hand surgery utilizing automated mobile phone text messaging.

METHODS: Inclusion criteria included any adult (≥ 18 years old) with a mobile phone capable of text messaging who was undergoing a common ambulatory hand surgical procedure. Data collection began on the day of surgery, termed study day (SD) 0. The participants received a text message on the evening of SD 0 inquiring about pain level (0-10) and how many tablets of prescription pain medication had been taken in the past 24 hours. On SD 1-SD 3, individuals received three pain inquiries and a once daily prescription pain medication inquiry. On SD 4-SD 6, individuals received a daily pain and prescription pain medication inquiry. Initial one week completion rate was assessed and compared between different cohort demographics.

RESULTS: Twenty patients with an average age of 44.4 years (range 22-70 years) enrolled in the pilot investigation--65% were female, 42% had completed college, and 65% were working. Total completion rate of both pain and narcotic medication questions through 7 days was 91%. There were no differences in completion rate by sex, those who had completed college compared to those with less than a college degree, or age greater than 40 years old compared to age less than or equal to 40 years old. During the initial one week pilot study period, patients reported an average use of 33% (range 0-83%) of their prescribed narcotic medication for that week.

DISCUSSION: Patients had a high completion rate of 91% of all questions suggesting that automated software delivery of text messages through mobile phones is a feasible method to retrieve patient data. Most patients utilized only a small percentage of the prescribed narcotic medication suggesting an opportunity to curtail narcotic over-prescription and reduce opioid diversion.

Are Serum Inflammatory Markers Helpful in the Diagnosis of Acute Hand Infections?

Abstract ID: Paper 016

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PURPOSE: To evaluate the effectiveness of using common serum inflammatory markers, specifically white blood cell count (WBC), erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP), in diagnosing common upper extremity infections. We hypothesized that these inflammatory markers play no role in the diagnosis of hand/upper extremity infections and are unnecessary medical tests to order during patient work-up and evaluation.

METHOD: Retrospective review of 150 patients consulted on for evaluation of hand/upper extremity infections (elbow and distal) who underwent initial screening with serum inflammatory markers (WBC, ESR, and CRP). Patients were excluded if they had other causes for elevated markers (ex. UTI, rheumatoid arthritis) or an inability to mount a normal inflammatory reaction (ex. steroid use). The primary outcome measure was the presence or absence of infection. Additional data was recorded in regard to patient demographics, risk factors/comorbidities, location and depth of infection, infectious organism, and ultimate treatment.

RESULTS: There was no significant difference between inflammatory markers in the presence (WBC: 11.3, ESR: 36, CRP: 45) or absence (WBC: 10.4, ESR: 37, CRP: 41) of infection. However, ESR was significantly more elevated in the gout/pseudogout subgroup (84.5) compared to the septic arthritis subgroup (40). Analysis of infected patients revealed significantly elevated ESR levels (38.5 vs. 24) and a trend towards elevated CRP levels (43 vs. 21.4) in the surgically managed group compared to the group managed with antibiotics alone. Forearm and intramuscular infections resulted in the highest WBC and CRP levels, whereas finger, skin, and tendon sheath infections displayed the lowest levels. There was no significant difference between inflammatory markers in MRSA and non-MRSA infections. There was a weak positive correlation between the number of comorbidities/risk factors and ESR levels.

CONCLUSION: Serum inflammatory markers have little role in the diagnosis of upper extremity infections. However, when assessing a known infection, higher CRP and ESR levels may suggest the need for surgical intervention as opposed to antibiotic treatment alone.

Activation of the First Dorsal Interosseous Results in Radiographic Reduction of the Thumb Carpometacarpal (CMC) Joint

Abstract ID: Paper 017

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INTRODUCTION: Hypermobility of the carpometacarpal (CMC) joint is a well described etiological factor in the development of thumb arthritis. Hypermobility leads to joint subluxation and osteoarthritis secondary to resultant joint incongruity. We hypothesize that activation of the First Dorsal Interosseous (FDI) muscle will radiographically reduce subluxation of the 1st metacarpal relative to the trapezium.

METHODS: Subjects at least 18 years old were recruited. Exclusion criteria included positive grind test, pregnancy, and major conditions of ligamentous laxity. A certified hand therapist performed a grind test on all subjects. Using a hand-held manometer, maximal voluntary contraction of the FDI as measured by the Rotterdam Intrinsic Myometer; lateral pinch strength, and grip strength were measured. Fluoroscopy was used to obtain true AP radiographs of the CMC joint at (1) rest, (2) while stressed without activation of the FDI, and (3) while stressed with activation of the FDI. Radial subluxation of the base of the first metacarpal and metacarpal width were measured by 3 blinded surgeons as described by Wolf (2011). The ratio of radial subluxation to the articular width was calculated.

RESULTS: Seventeen subjects with 34 thumbs including 5 males and 12 females participated. Average age was 25.9 (21-59). Thirteen right-handed, 1 left-handed, and 3 ambidextrous subjects were included. Two thumbs were excluded for a positive grind and one for poor radiograph quality. Thirty-one thumbs were evaluated. Average maximal voluntary contraction of the FDI was 27N, lateral pinch 81N, and grip strength 347N.

Twenty-six thumbs demonstrated subluxation when stressed and reduction after firing of the FDI. Three thumbs were not subluxed at rest and did not sublux with stress, consistent with stiff CMC joints. Two thumbs were subluxed at rest but did not further sublux with stress. Inter-rater reliability was high (96%). In the 26 thumbs that demonstrated increased subluxation with stress, subluxation while stressed averaged 48% (29-75) of metacarpal articular width. FDI activation reduced subluxation by an average of 80% (20-120). The two thumbs with the same degree of subluxation at rest and with stress had subluxation 43% and 63% of articular width. Reduction with FDI activation was 67% and 28%, respectively.

CONCLUSION: The FDI radiographically reduces subluxation of the thumb CMC joint. Strengthening the FDI may be effective in preventing thumb arthritis.

MAOA BREAKOUT SESSION #2
SPORTS
April 14, 2016

Internal Fixation of Unstable Osteochondritis Dissecans in the Skeletally Mature Knee With Metal Screws

Abstract ID: Paper 018

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PURPOSE: Osteochondritis dissecans (OCD) in skeletally mature patients commonly requires surgical treatment due to the decreased healing rate compared to juvenile OCD. Although bioabsorbable and metal options are available for internal fixation, a lack of consensus exists on the ideal construct for the unstable lesion in these patients. The purpose of this study was to determine the radiographic healing rates and mid-term clinical outcomes after use of headless metal compression screws for the treatment of unstable osteochondritis dissecans lesions in the knees of skeletally mature patients.

METHODS: A comprehensive retrospective chart review for all skeletally mature patients who presented with unstable femoral condyle osteochondritis dissecans lesions of the knee was conducted. All patients included underwent treatment with reduction and internal fixation using metal compression screws. Preoperative and postoperative radiographs were reviewed for all patients. Patients were considered skeletally mature if complete physis closure was observed on preoperative radiographs. Postoperative healing was defined as radiographic evidence of union of the OCD progeny fragment with the condyle. To collect clinical outcome data, patients were contacted retrospectively and administered three validated outcome surveys: IKDC, KOOS, and Marx.

RESULTS: A total of 22 knees in 22 patients were included, consisting of 16 males and 6 females with a mean age of 21 years at the time of surgery (range, 14–37). 16 knees demonstrated medial condyle lesions, 6 knees involved the lateral condyle. Metal headless cannulated compression screws were used as the fixation device in all 22 cases. At a mean of 31 months postoperatively (range, 2–262), fragment union was observed in 18 knees (82%). 11 of these 18 went on to planned hardware removal. 6/6 lateral condyle lesions were healed vs. 12/16 medial condyle lesions. The remaining 4 knees (18%) required loose fragment excision and hardware removal at a mean of 9 months (range, 2–16) postoperatively. At an average follow-up of 8.7 years (1-22 years), mean postoperative Marx score was 7 (range, 0-16). The mean postoperative IKDC score was 85 (range, 62-100). Mean KOOS scores were as follows:

KOOS Pain (93; range, 69-100), KOOS Symptoms (86; range, 71-100), KOOS ADL (98; range, 90-100), KOOS Sports (82; range, 50-100), KOOS QOL (76; range, 50-100).

CONCLUSION: Metal compression screws provide an effective modality for treating unstable osteochondritis dissecans lesions in skeletally mature patients. At mid-to long-term follow-up, patients have excellent knee function and maintain satisfactory activity levels.

Quadriceps Tendon vs. Hamstring Tendon Autograft in Anterior Cruciate Ligament Reconstruction: Systematic Review and Meta-Analysis

Abstract ID: Paper 019

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INTRODUCTION: Anterior cruciate ligament (ACL) reconstruction is one of the most commonly performed orthopedic procedures in the United States. Graft choice remains as a controversial topic when it comes to ACL reconstruction. The use of quadriceps tendon as a graft for ACL reconstruction has gained popularity in recent years. This study aims to compare quadriceps tendon autograft to the traditional soft-tissue hamstring autograft in ACL reconstruction through a systematic review and meta-analysis.

METHODS: A Medline database (1946 to April 2015), through Ovid, was searched using MeSH term Anterior Cruciate Ligament yielding 7045 references. Our search was narrowed to English-language, quadriceps tendon autograft references yielding 57 titles, and hamstring tendon autograft yielding 106 titles. Only clinical studies from 2005 until the time of the search were considered, and each reviewed for their relevance and available outcome data, with minimum of two-year clinical follow-up.

RESULTS: Ten clinical studies pertaining to quadriceps tendon autograft were found to be relevant to our study, yielding a total of 827 ACL reconstructions using quadriceps tendon alone, or quadriceps tendon with bone-plug. Fourteen clinical studies pertaining to hamstring tendon autograft were included, yielding a total of 896 ACL reconstructions using hamstring tendon autograft. IKDC and Lysholm scores were higher for the hamstring group compared to the quadriceps tendon group (92.3 vs. 90.0, $p = 0.0065$) and (87.6 vs. 86.2, $p = 0.0642$), respectively. Lachman's and pivot shift stability testing were negative for the quadriceps tendon group in 86.9% and 92.7%, and negative in the hamstring tendon group in 79.7% and 81.3%, respectively. Relative risk reduction for the quadriceps group compared to the hamstring group was 35.2% (95% CI: 0.51 - 0.82, $p = 0.0003$) for a positive Lachman's and 60.8% (95% CI: 0.29 - 0.52, $p < 0.0001$) for a positive pivot shift testing.

CONCLUSION: Quadriceps tendon autograft is comparable to hamstring tendon autograft in ACL reconstruction. The quadriceps tendon group yielded a statistically significant lower risk of a positive Lachman's and pivot shift testing at minimum 2 years follow-up, while the hamstring group provided higher IKDC and Lysholm scoring. While quadriceps tendon autograft has recently become popularized as a graft choice in ACL reconstruction, more well-designed clinical studies are needed to further compare it to other autograft options.

Return to Sport After Articular Cartilage Repair in the Knee

Abstract ID: Paper 020

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INTRODUCTION: Articular cartilage injuries in athletes can lead to decreased athletic participation/level and early osteoarthritis. To date, the optimal surgical treatment of chondral defects in an athletic population remains highly controversial and has yet to be determined. The purpose of this review was to (1) report data on return to sport and (2) compare activity and functional outcome measures following various cartilage restoration techniques.

METHODS: A comprehensive review of the literature was performed with specific inclusion criteria for studies with return to sport outcomes after microfracture (MFX), osteochondral autograft transfer (OAT), osteochondral allograft transplantation (OCA), and autologous chondrocyte implantation (ACI). Studies meeting inclusion criteria contained International Cartilage Repair Society grade III or IV chondral defects in the knee. All level I and II studies containing return to sports participation were included, as well as level III and IV studies with minimum 2-year postoperative activity-based outcomes.

RESULTS: Forty-four studies met inclusion criteria (18 level I/II, 26 level III/IV). 2549 patients were included (1756 M, 793 F) with an average age of 32.7 years and follow-up of 48 months (ACI, 1334; MFX, 858; OAT, 261; OCA, 96). Return to sport at some level was 76% overall, with highest rates of return after osteochondral autograft transfer (90%; $p<0.01$) and osteochondral allograft transplantation (88%; $p<0.01$). Osteochondral autograft transfer showed the fastest return to sports (5.2 ± 1.8 months) compared to 9.1 ± 2.2 months for MFX, 15.3 ± 4.1 months for ACI, and 9.6 ± 3.0 months for OCA ($p<0.001$). KOOS-Sport scores were similar at baseline, but at 2 years OAT was significantly higher than all other groups ($p<0.001$) and at 5 years OAT and OCA were both superior to MFX ($p<0.001$) and ACI ($p<0.001$; Figure 1). Conversely, Tegner scores were higher for MFX over ACI at two years ($p<0.001$), but at 5 years no differences were found between groups. MFX ($p=0.003$) and ACI ($p=0.02$) had significant decreases in Tegner scores from 2 to 5 years (Figure 2).

CONCLUSION: In a review of 2549 athletes, cartilage restoration surgery had a 76% return to sport at mid-term follow-up. Osteochondral autograft transfer offered a faster recovery and appeared to have a higher rate of return to pre-injury athletics, but lesion size and athlete age more be more important predictive factors than the method of treatment.

Click here to view Figure 1

Click here to view Figure 2

Increased Risk of Second Anterior Cruciate Ligament Injury for Female Soccer Players

Abstract ID: Paper 021

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OBJECTIVE: Female soccer players have a well-known risk for anterior cruciate ligament (ACL) injury, but few studies have reported on second ACL injuries in this population. The purpose of this study was to (1) report the rate of subsequent ACL injury (graft rupture or contralateral tear) in competitive female soccer players, (2) compare rates to those of other female athletes, and (3) determine risk factors for second ACL injury in this athletic population.

METHODS: A retrospective review of patients treated with primary ACL reconstruction between 1998 and 2013 at our institution was carried out. Female athletes with at least two years of follow-up were included for further review. Patient outcome was obtained via Lysholm and IKDC scores. Chi-square analysis was used to compare rate of graft rupture and contralateral ACL injury based on preoperative Tegner score, graft type, and injury side for soccer players vs. other female athletes. Wilcoxon rank-sum test was used to compare rate of subsequent ACL injury to patient age.

RESULTS: 365 patients (103 soccer; 262 non-soccer athletes) with a mean age of 24.0 years were included. No baseline patient demographical differences were found between the soccer and non-soccer group. Soccer players sustained both more graft ruptures (14.9% vs. 2.3%, $P < 0.001$) and contralateral ACL tears (22.4% vs. 6.1%, $P = 0.04$) than non-soccer players. Younger age (mean 16.0 vs. 24.3 years; $P < 0.0001$) and higher Tegner Activity Level scores (mean 8.1 vs. 7.4, $P = 0.049$) were risk factors for ACL graft tear but not contralateral ACL injury. Graft selection and injury side showed no statistical significance on graft rupture or contralateral injury. Soccer and non-soccer players had similar mean Lysholm (96 vs. 95) and IKDC scores (95 vs. 96) at final follow-up.

CONCLUSION: Female soccer players with prior ACL reconstruction had an increased rate of both graft retear and contralateral ACL injury compared to a similar group of non-soccer female athletes. Thirty-seven percent of players that returned to soccer had a second ACL tear with the rate of contralateral tears being almost double that of re-tears. Young age and higher activity level were risk factors for graft rupture in this population of female athletes.

Repair vs. Reconstruction of the Medial Collateral Ligament in the Multi-Ligamentous Injured Knee

Abstract ID: Paper 022

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Multiligamentous knee injuries (MLKI) are complex injuries to treat. Historically, most isolated medial collateral ligament (MCL) tears have been treated nonoperatively. However, there is debate about how to address the MCL tear in the setting of MLKI. In the review study done by Kovachevich et al., there seemed to be no difference in outcomes between repair of the MCL and reconstruction. In their review, there were 60 patients across 5 studies who underwent MCL repair for either traumatic MCL in the setting of MLKI, or after a knee dislocation. They compared this to 26 patients across 3 included studies who underwent MCL reconstruction in the setting of MLKI. None of the studies that were included were level I, II, or III evidence, though their conclusion was that both repair and reconstruction of the MCL produced satisfactory results. The MCL provides stability to valgus loads as well as secondary restraint to tibial external rotation. It stands to reason that in MLKI, an insufficient MCL could allow for a less stable knee, and have a detrimental effect on the healing of the other injured ligaments. No study, to our knowledge, has directly compared outcomes of repair vs. reconstruction of the insufficient MCL in the setting of MLKI.

METHODS: 41 patients who sustained a MLKI with grade 3 valgus instability at 0° and 30° of knee flexion qualified for the study. The data was collected from 2006 through 2015. Each patient who underwent surgery for MLKI were given IKDC knee evaluation forms and the Lysholm knee scoring scale postoperatively. Knee stability with valgus load was also tested in the clinic postoperatively. Those who had undergone surgery for an insufficient MCL were then stratified into repair vs. reconstruction groups. The repair group had 23 total patients entered, with 11 completing both the IKDC and Lysholm forms. The reconstruction group had 18 patients entered, with 11 completing the forms.

RESULTS: Mean IKDC and Lysholm scores in the repair group were 50 and 64, respectively. In the reconstruction group, mean IKDC and Lysholm scores were 61 and 68, respectively. Mean MCL laxity in the repair group was 0.4. The mean MCL laxity in the reconstruction group was 0.9.

Predictors of Knee Stiffness Following Surgical Management of Multi-Ligament Knee Injuries

Abstract ID: Paper 023

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INTRODUCTION: Postoperative knee stiffness can influence outcomes following operative treatment of multi-ligament knee injuries (MLKI). The purpose of this study was to evaluate the impact of patient and surgical factors may potentially contribute to stiffness following multi-ligamentous knee surgery.

METHODS: Over a 10-year period, a retrospective review was conducted and surgically managed MLKIs involving two or more ligaments were identified. Patients were classified as "stiff" postoperatively if they (1) underwent a manipulation under anesthesia with or without arthroscopic lysis of adhesions or (2) failed to reach 120° degrees of flexion at final follow-up. Patient and surgical factors were evaluated systematically. Student's t-test was used to compare continuous variables and chi-squared test was used to compare continuous variables. Significance was set as $p<0.05$.

RESULTS: Overall, 26/121 (21.5%) of patients were diagnosed with postoperative stiffness. The mean age was 27.6 years at the time of surgery. The mean follow-up was 50 weeks. In the acute postoperative phase, 17 patients underwent manipulation under anesthesia. Univariate analysis failed to identify differences in age, body mass index, external fixation use, or surgical timing (acute vs. chronic) between stiff and normal knees. Factors associated with the development of postoperative stiffness include knee dislocation (KD III or IV) ($p= 0.04$), high-energy mechanism ($p= 0.02$), and posterior cruciate ligament (PCL) reconstruction or repair ($p= 0.02$).

CONCLUSIONS: Surgeons may utilize knee external fixation if necessary without increasing the rate of long-term stiffness. Further, acute surgery does not appear to influence the incidence of manipulation or stiffness. Careful attention to postoperative rehabilitation regimens should be given to patients with high-energy injuries, knee dislocations (KD III or IV), or those undergoing PCL reconstruction or repair.

ACL Reconstructed Patients Have Persistent Hip Strength and Functional Deficits After Return-to-Play

Abstract ID: Paper 024

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Current return to play guidelines after ACL reconstruction (ACLR) are controversial, and no standardized parameters exist. Readiness for return to sports is usually based on a combination of factors, including surgeon preference, physical therapist assessment, functional tests, and time from surgery. However, recent studies have suggested that ACLR patients may have persistent functional deficits even after returning to competitive sports. The purpose of this study was to investigate the lower extremity strength and functional test performance of ACLR patients who had been cleared to return to sports.

METHODS: In this IRB-approved study, we reviewed prospectively-collected data on patients who underwent ACL reconstruction by fellowship-trained sports medicine orthopedic surgeons at our academic hospital. Twenty consecutive autograft ACLR patients who had been allowed to return to competitive sports by their surgeon and therapist were matched with 20 control subjects from a healthy, non-injured population. A strap-stabilized dynamometer was used to measure isometric hip abduction (HABD), hip extension (HEXT), hip external rotation (HER), and knee extension (KEXT) strength. Single leg, timed, triple, and crossover hop tests and a timed 60-second single leg step down (SLSD) test were administered using previously described standardized protocols. Data was tested for normality using the Shapiro-Wilk test. Means between groups were compared using a two-tailed t-test, and categorical data was analyzed using the chi-square test. Significance was set at $p \leq 0.05$.

RESULTS: Testing was performed on 40 subjects (20 ACLR, 20 control) with a mean age of 24.15 (range 15-45) years. Twenty-two females (55%) and 18 males (45%) participated. Mean time from surgery for the ACLR group was 8.26 months (range 6-14). There were no significant differences in age, gender, BMI, or baseline Tegner activity levels between the two groups. HER strength ($p=0.043$) was significantly lower in the ACLR group as compared to the controls. Mean number of repetitions in the timed SLSD was significantly lower ($p=0.026$) for the ACLR group (31.80, SEM=2.6) as compared to the control group (40.05, SEM=2.4). Performance in the single leg ($p=0.003$), timed ($p=0.017$), triple ($p=0.005$), and crossover (0.015) hop tests were significantly worse for the ACL-R group as compared to the control group. No differences were seen in HEXT, HABD, or KEXT strength between groups.

DISCUSSION AND CONCLUSION: At a mean follow-up time of over eight months, ACL reconstructed patients who had been cleared to return to sports exhibited deficiencies in hip external rotation strength, SLSD performance, and hop test performance as compared to a matched control group. The worse performance of ACLR subjects on the SLSD test but not KEXT strength test indicate that some ACLR subjects deemed ready for sports may continue to lack the power and endurance needed for successful sports participation. These results suggest that more objective measures should be used when evaluating patients' return to play readiness.

Does Proximal-Distal Tibial Tunnel Placement for PCL Reconstruction Matter?

Abstract ID: Paper 025

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BACKGROUND: PCL reconstruction using the transtibial technique is a technically challenging procedure in part due to challenges with drilling an anatomic tibial tunnel. It is most commonly performed using a single bundle, which seeks to reconstruct the anatomy of the anterolateral bundle of the PCL. A common mistake is to exit the PCL tunnel too proximal on the posterior tibia rather than in an anatomic location, which is at the footprint of the PCL on the tibia about 1 cm distal to the joint line. This study examined the biomechanical effects of proximal-distal tibial tunnel placement on posterior laxity in PCL reconstruction.

METHODS: Eighteen human cadaveric knees were studied, consisting of nine matched pairs. Transtibial PCL reconstruction was performed using a simulated arthroscopic technique. The native PCL was resected, and Achilles tendon autografts were used for PCL reconstruction. The specimens were divided into two groups based on tibial tunnel placement: (1) anatomic tunnel and (2) non-anatomic tunnel. The anatomic tibial tunnel was placed at the footprint of the PCL, 1 cm distal to the joint line, while the non-anatomic tibial tunnel was placed more proximal to this, at the joint line. A 150-N cyclic posterior tibial load was applied using a Materials Testing System (MTS) machine at 0°, 30°, 60°, and 90° of knee flexion. In 10 specimens, a static 250-N posterior tibial load was applied at 90° of knee flexion. Posterior tibial translation in the sagittal plane was recorded. A Mann-Whitney U test was used to compare posterior tibial translation between the two groups. Statistical significance was set defined as $p < 0.05$.

RESULTS: With application of a 150-N posteriorly directed cyclic force, the anatomic tunnel group demonstrated significantly less posterior tibial translation than the proximal non-anatomic tunnel group at 0°, 30°, 60°, and 90° of knee flexion ($p < 0.05$). The anatomic tunnel group also demonstrated significantly less posterior tibial translation than the non-anatomic tunnel group at 90° with a static 250-N posteriorly directed force applied ($p < 0.05$).

CONCLUSION: Anatomic distal tibial tunnel placement recreating the tibial origin of the PCL provided significantly greater restraint to posterior tibial translation than proximal tunnel placement. We recommend careful placement of an anatomic distal tibial tunnel during PCL reconstruction for avoidance of posterior laxity. Further clinical studies are warranted to corroborate this finding.

The Relationship Between Posterior-Inferior Tibial Slope and Bilateral, Non-Contact Anterior Cruciate Ligament Injuries

Abstract ID: Paper 026

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PURPOSE: The purpose of this study is to investigate the association between the posterior-inferior tibial slope (PITS) and non-contact bilateral anterior cruciate ligament (ACL) injuries compared to a group of unilateral non-contact ACL injuries and a normal cohort without ACL insufficiency. We believe that the PITS will be significantly increased in patients with bilateral non-contact ACL injuries as compared to the unilateral ACL group and with the normal control cohort without ACL insufficiency.

MATERIALS AND METHODS: Using a computerized relational database, we retrospectively identified patients who underwent surgical reconstruction or treatment by a single surgeon between 1995 and 2013. All patients with bilateral ACL injuries, unilateral ACL injuries, or patella femoral pain syndrome were included. Exclusion criteria included concomitant ligament injuries, previous ACL reconstruction, prior knee surgery, and those in which plain lateral radiographs were unavailable. Fifty patients were randomly selected from each group.

RESULTS: The mean PITS angle for the non-contact bilateral cohort was the highest of the three groups measured (11.8° ± 2.3°). The unilateral ACL cohort measured a PITS angle of (9.3° ± 2.4°). The non-contact normal group had the lowest mean PITS angle (7.5° ± 2.3°). The difference between the mean angles of the non-ACL cohort and both the bilateral and unilateral cohorts was statistically significant, with $p<0.001$. The bilateral cohort was noted to have a mean difference of 2.35° and 4.19° from the unilateral and control cohorts, respectively. These values were noted to be clinically significant. There was a significant association between Tegner activity level (1-3, 4-6, 7-10) and the type of knee injury (non-ACL, unilateral, bilateral) ($p< .001$). Higher Tegner scores were associated with an increased risk of injury. Controlling for Tegner activity level, an increase in PITS angle of 1° was associated with a 18% ($p<.001$) and 15% ($p<.001$) increase in risk of injury comparing the bilateral group to the control group and unilateral group, respectively.

CONCLUSION: The current study demonstrates that increased posterior-inferior tibial slope is associated with an increased susceptibility to non-contact bilateral ACL injury. Furthermore, there is an approximate increase in risk of ACL injuries associated with PITS values exceeding 10°. This angle has a sensitivity and specificity of detecting knee injury (bilateral vs. control) of 78% and 86%, respectively.

Extra-Articular, Intra-Epiphyseal Drilling for Osteochondritis Dissecans of Knee: A Study of Three-Dimensional Modeling to Characterize a Safe and Reproducible Surgical Approach

Abstract ID: Paper 027

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BACKGROUND: Surgical treatment of Osteochondritis Dissecans (OCD) lesions of the knee is evolving. Both transchondral and extra-articular drilling of the subchondral bone are supported as efficacious treatment modalities. However, the extra-articular approaches, while technically more challenging, can address the subchondral bone without damage to the articular cartilage.

OBJECTIVE: The purpose of this study is to determine safe and reproducible tunnel entry points, trajectories, diameters, and distances through the medial femoral condyle to reach the OCD target without damaging the articular or physeal cartilage in skeletally immature patients.

METHODS: Seventeen MRI scans from skeletally immature patients were used to create three-dimensional models of the knee joint for analysis. Virtual representations of an OCD lesion were placed in the lateral aspect of medial femoral condyle (MFC), and cylinders simulating tunnel length, diameter, and trajectory were superimposed onto the models and measurements were taken.

RESULTS: Anterior to the MCL on the MFC, we discovered a circular “safe window” with a diameter of 10.3±1.4 mm, centered 12.1 ± 3.5 mm anterior and 2.4 ± 3.5 mm inferior to the medial epicondyle. The tunnel center traversed the skin 16.9 ± 12.1 mm anterior and 7.1 ± 5.9 superior to the medial epicondyle and had an average epiphyseal length of 31.8 ± 3.7 mm. In the coronal plane, the tunnel ran at an angle of 44.5 ± 10.3° to the longitudinal axis of the femur (49.7 ± 9.3° to the joint line). In the sagittal plane, the tunnel ran 46.4 ± 9.3° relative to the femoral axis (43.7 ± 9.7° to the joint line).

Posterior to the MCL on the MFC, we discovered a circular “safe window” with a diameter of 7.8±1.8 mm centered 8.6 ± 2.6 mm posterior and 5.1 ± 4.2 mm superior to the medial epicondyle. The tunnel center traversed the skin 9.4 ± 5.1 mm posterior and 26 ± 14.0 superior to the medial epicondyle and had an average epiphyseal length of 33.5 ± 4.5 mm. In the coronal plane, the tunnel ran at an angle of 43.9±10.0° to the longitudinal axis of the femur (50.7 ± 9.3° to the joint line). In the sagittal plane, the tunnel ran10.8 ± 6.9 º relative to the femoral axis (52.0± 21.9° to the joint line).

CONCLUSION: MRI derived three-dimensional modeling helps define relevant anatomical relationships and discover a safe surgical window to perform extra-articular intra-epiphyseal drilling of OCD lesions of the medial femoral condyle.

The Role of Patient Demographics in Patellar Tendon Dimensions

Abstract ID: Paper 028

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INTRODUCTION: Bone-patellar tendon-bone (BPTB) autograft is a popular tissue option for reconstruction of the anterior cruciate ligament (ACL). However, it is generally recommended not to harvest BPTB from patients with insufficient patellar tendon (PT) widths. Little is known preoperatively about which patients are at risk of having a small PT. The goal of this study was to define the standard size of the PT and evaluate its variability across different patient demographics.

METHODS: Magnetic resonance imaging (MRI) studies of the knee were retrospectively reviewed for 190 adult patients. On coronal images, the width of the PT was measured and recorded at its largest location. The thickness and length of the PT were similarly recorded from axial and sagittal images. Demographic information for each patient was gathered from the medical center's electronic medical record. Statistical analysis was performed using Pearson's correlation coefficient (r), Student's t-test, and ANOVA. An alpha level of 0.05 was utilized for significance determination.

RESULTS: The study included 63 males and 127 females. 100 patients were African-American, 42 Non-Hispanic Caucasian, 24 Hispanic, and 7 Asian. 17 patients were listed as 'other'. The mean PT width, length, and thickness were 27.0 mm (20.0-35.8), 45.7 mm (34.3-63.9), 4.6 mm (2.4-8.0), respectively. Female patients had PTs that were significantly narrower (26.0 mm vs. 29.1 mm, $p<0.01$) and shorter (44.7 mm vs. 47.7 mm, $p<0.01$) than males. Patients under 168 cm tall had PTs that were significantly narrower (26.0 mm vs. 28.2 mm, $p<0.01$) and shorter (44.1 mm vs. 47.4 mm, $p<0.01$) than patients 168 cm or taller. Patients under 82.993 kg had PTs that were significantly narrower (26.3 mm vs. 27.7 mm, $p<0.01$) and shorter (43.9 mm vs. 47.5 mm, $p<0.01$) than patients 82.993 kg or heavier. PT length demonstrated statistically significant variability based on patient ethnicity ($p<0.01$). African Americans had the longest PT at 47.3 mm while patients classified as other averaged 42.0 mm. PT width and thickness did not demonstrate significant variability based on ethnicity ($p=0.28$ and $p=0.07$).

CONCLUSION: This study suggests that the standard PT, after taking into account the MRI magnification factor, is 27.0 mm wide, 45.7 mm long, and 4.6 mm thick. The dimensions of the PT demonstrate variability based on different patient demographic factors. Female patients who are under 168 cm tall and weigh less than 82.993 kg are at the greatest risk of having a PT that is not wide enough for use during ACL reconstruction. Preoperative consideration should be given to other graft tissue sources when demographic risk factors for a small PT are present.

Magnetic Resonance Imaging of Osteochondritis Dissecans: Does MRI Accurately and Consistently Predict Lesions' Stability?

Abstract ID: Paper 029

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BACKGROUND: Treatment of osteochondritis dissecans (OCD) of the knee depends on the determination of stability of the lesion, with unstable lesions being more likely to need operative treatment. Magnetic resonance imaging criteria have been established to determine preoperative stability; but accuracy has varied, largely depending on the age of the patient.

PURPOSE: To retrospectively determine the diagnostic accuracy of routine clinical magnetic resonance imaging (MRI) of the knee on lesion stability in patients with osteochondritis dissecans (OCD). It is hypothesized that specific assessment criteria will enable improved assessment of lesion grade and stability in OCD.

MATERIALS AND METHODS: The local institutional review board (IRB) approved this HIPAA-compliant retrospective study; the requirement for informed consent was waived. Routine MRI studies of 46 consecutive patients with arthroscopically proven OCD lesions (mean age, 23.7 years; 26 male, 16 female) were assessed by three radiologists who were blinded to arthroscopic results. Arthroscopies were evaluated by two orthopedic surgeons in consensus. OCD criteria of the International Cartilage Repair Society (ICRS) were applied to arthroscopy and imaging interpretations. Inter-rater correlation statistics, accuracy of MR grading with respect to “Gold Standard” arthroscopy were determined.

RESULTS: For all readers combined, the respective sensitivity, specificity, and accuracy of MR imaging to determine lesion stability was 70%, 81%, and 76%. When compared to the original MRI report, the overall accuracy increased from 53% to 76%, when readers were given specific criteria based on the OCD ICRS classification. However, inter-reader variability remained high with Krippendorf’s alpha ranging 0.48-0.57.

CONCLUSION: Accuracy of MRI evaluation of OCD lesions validated against arthroscopy increased significantly when readers are provided with specific assessment criteria; however, poor inter-rater agreement remained, emphasizing the need to also focus on image acquisition schemes to better depict the very nature of the disease.

NFL Combine Athletic Performance After ACL Reconstruction

Abstract ID: Paper 030

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BACKGROUND: Anterior cruciate ligament (ACL) injuries are common and potentially career-threatening injuries in the National Football League (NFL). Although statistical performance has been demonstrated after ACL reconstruction, functional performance is not well defined.

HYPOTHESIS/PURPOSE: To determine the functional performance of NFL combine participants after ACL reconstruction compared to an age, size, and position-matched control group. We hypothesize that there is no difference between players after ACL reconstruction as compared to controls in functional athletic performance.

STUDY DESIGN: Retrospective Case Control; Level of evidence, 3.

METHODS: Ninety-eight NFL caliber athletes who had undergone primary ACL reconstruction and participated in the NFL scouting combine between 2010-2014 were reviewed and compared to an age, size, and position-matched control group. Data that were recorded for each player included: 40-yard dash, vertical leap, broad jump, shuttle drill, and 3-cone drill.

RESULTS: In regards to speed and acceleration, average reconstructed players 40-yard dash time was 4.74 seconds (range: 4.33- 5.55) compared with controls at 4.74 seconds (range: 4.34-5.38) (p=0.96). Jumping performance was also similar with mean reconstructed player vertical leap of 33.35 inches (range: 23-43) and standing broad jump of 113.9 inches (range: 96-136) compared to 33.22 inches (range: 23.5-43.5) (p=0.839) and 113.9 inches (range 92-134) (p=0.992) in the controls, respectively. Agility and quickness testing measures also did not show a statistically significantly difference with reconstructed player performance in the shuttle and 3 cone drill times of 4.37 seconds (range: 4.02-4.84) and 7.16 seconds (range: 6.45-8.14), respectively, compared to controls times of 4.37 seconds (range: 3.96-5.0) (p=0.906) and 7.18 seconds (range: 6.64-8.24) (p=0.745).

CONCLUSIONS: This study suggests that after ACL reconstruction high level athletes have equivalent performances with no statistically significant differences compared to matched controls. This information is unique when advising high level athletes on athletic performance after ACL reconstruction, suggesting that those who fully recover and return to play appear to have no decrement in athletic performance.

MAOA BREAKOUT SESSION #3
TRAUMA
April 14, 2016

Aspirin Utilized for DVT Chemoprophylaxis Delays Healing and Increases Nonunions in Tibial Shaft and Plafond Fractures

Abstract ID: Paper 031

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BACKGROUND: Tibial shaft and plafond fractures frequently have poor healing, resulting in non- and delayed unions. Deep vein thrombosis (DVT) and pulmonary embolism (PE) incidence increase after trauma, particularly with lower extremity fractures and immobilization. Aspirin inhibits platelet aggregation and is frequently utilized for DVT and PE chemoprophylaxis after lower extremity trauma. Aspirin also inhibits cyclooxygenase (COX) enzymes. COX enzymes produce prostaglandins, which are integral to fracture healing. Previously, other COX enzyme inhibitors have been implicated in delayed fracture healing. We hypothesized that aspirin utilized for DVT chemoprophylaxis after tibial shaft and plafond fractures would inhibit fracture healing.

METHODS: Patient charts from a single academic center were investigated utilizing ICD-9 codes identifying tibial shaft and plafond fractures from 2005 through 2014. Patients with follow-up longer than five weeks were analyzed for radiographic and clinical healing, totaling 163 patients from 559 reviewed charts. Those who had follow-up to completion of treatment, being 133 patients, were included for the analyses of nonunion, delayed union, bone stimulator use, repeat surgery, or composite event which included any of the prior. The two-tailed Student T test and Kaplan Meier Analyses were utilized for statistical analysis.

RESULTS: In tibial shaft and plafond fractures, aspirin 325 mg daily for DVT chemoprophylaxis significantly increased fracture nonunions from 4% to 20% ($p=0.012$) and composite events from 19% to 42% ($p=0.005$) compared to the non-aspirin group. Aspirin significantly delayed radiographic bridging of one and three cortices and clinical healing compared to other anti-coagulation modalities. Median bridging time for one and three cortices and clinical healing for the aspirin group was 87, 133, and 129 days compared to the non-aspirin group with 68, 96, and 97 days, respectively. Open fractures significantly increased delayed unions ($p=0.004$) and composite events ($p=0.023$). Surgery, smoking, and diabetes did not significantly affect fracture healing. There was no statistical difference in DVT formation between aspirin and other forms of anti-coagulation.

DISCUSSION: Aspirin utilized for DVT chemoprophylaxis significantly delayed tibial shaft and plafond fracture healing and increased nonunions and composite events. Aspirin was a greater risk factor for adverse events than any other factor analyzed. We recommend careful consideration for DVT chemoprophylaxis following tibial shaft and plafond fractures.

Does the Angle of the Nail Matter? The Importance of Matching Neck-Shaft Angles in Intertrochanteric Fractures

Abstract ID: Paper 032

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INTRODUCTION: Unstable intertrochanteric fractures are often treated with cephalomedullary nails (CMN) and these are available in a variety of neck-shaft angles (NSA). There are no published data supporting or refuting the concept that matching the nail NSA to the native NSA affects the outcome. A mismatched native NSA to nail NSA may result in fracture malreduction and or limit the ability of the neck to collapse along the axis of the screw.

METHODS: A retrospective review identified 70 unstable intertrochanteric fractures (AO/OTA 31-A2.2 and 31-A2.3) treated with Gamma-III CMN between 2005 and 2014. The following were reasons for exclusion: inadequate radiographs, deformity or prior fracture of the contralateral femur, and less than six months follow-up. Radiographs were reviewed to determine the contralateral NSA and the post-reduction NSA on the injured side. We then correlated the post-reduction NSA with CMN NSA match or mismatch.

RESULTS: Forty-four patients met the inclusion criteria, evenly divided between AO/OTA 31-A2.2 and 31-A2.3 fractures. Forty were treated with long nails and four with short nails. A nail NSA of 125° was used in 36, 120° in 1, and 130° in 7. Average age was 81 (range 43-96). Average follow- up was 49 months (9-112 months). The average nail NSA was 1° less than the native NSA (SD, +/- 7°). The average post-reduction NSA was 4° less than the native NSA (SD +/- 7°). Nails with a NSA less than the native NSA (negative nail NSA mismatch) were more likely to be reduced in varus (negative post-reduction NSA mismatch) (p=0.0001). Fixation failure occurred in 7 patients (10%). The nail NSA and post-reduction NSA mismatch did not differ between the surviving and failed groups. Four of the seven fixation failures involved short nails compared to none in the surviving group (p= 0.0003).

DISCUSSION AND CONCLUSION: Treatment of unstable intertrochanteric hip fractures with CMN with a NSA that is less than the native NSA increased the likelihood of a varus reduction. In order to achieve a neutral or valgus reduction, a nail should have a NSA that is greater than the native NSA.

MRSA Colonization is More Common in Orthopedic Trauma Patients Than Elective Total Joint Arthroplasty Patients

Abstract ID: Paper 033

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INTRODUCTION: Staphylococcus aureus (SA) skin colonization is a potentially modifiable risk factor for surgical site infections (SSIs). However, little is known whether interventions may impact SA-SSIs in patients that undergo operative fixation of acute fractures. The purpose of this study was to report preliminary results of a SA screening protocol for orthopedic trauma patients and compare the colonization rates of orthopedic trauma patients to patients undergoing elective total joint arthroplasty (TJA).

METHODS: Patients 18 or older indicated for operative fixation of acute fractures between August 1, 2014, and April 1, 2015, were enrolled in an IRB-approved prospective study to screen for SA nasal colonization. SA screening consisted of a nasal swab polymerase chain reaction (PCR) to evaluate for methicillin-sensitive SA (MSSA) or methicillin-resistant SA (MRSA) colonization. Patients who screened positive for MSSA or MRSA received 2% intranasal mupirocin ointment twice daily and 4% chlorhexidine wipes and shampoo for 5 days perioperatively. Patients who were colonized with MSSA received Cefazolin 2000 mg IV (for <120 kg) or 3000 mg IV (for >120 kg). Patients who were colonized with MRSA were given Cefazolin and a weight-adjusted dose of Vancomycin. We assessed the overall percentage of trauma patients who were colonized with either MSSA or MRSA and compared the incidence of colonization in patients indicated for elective TJA over the same time period at our institution.

RESULTS: 309 patients underwent operative treatment of acute fractures between August 1, 2014, and April 1, 2015. 261 (84%) of these patients were screened for MSSA/MRSA. Of the 261 patients, 69 patients (26.4%) screened positive for MSSA and 20 patients (7.6%) screened positive for MRSA. In comparison, 643 TJA patients were screened for SA over the same time period. Of these, 172 TJA patients (26.7%) screened positive for MSSA and 20 (3.1%) for MRSA. There were 6 wound-related related complications within the screened trauma population. Three patients developed deep SSIs requiring operative irrigation and debridement. One of these patients had previously screened positive for MSSA and MRSA and intraoperative cultures grew MRSA.

CONCLUSION: The incidence of MRSA colonization in patients indicated for operative fixation of fractures was higher than in patients undergoing elective TJA (7.6% vs. 3.1%). In contrast, the rate of MSSA colonization was similar between the two groups (26.4% vs. 26.7%). A SA screening and treatment program may be useful to reduce SA-SSIs in the musculoskeletal trauma population.

Intraoperative Temperature in Hip Fractures: Effect on Complications and Outcome

Abstract ID: Paper 034

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INTRODUCTION: Hip fractures are common orthopedic injuries and are associated with high morbidity and mortality. Not unlike other orthopedic procedures, intraoperative normothermia is a goal recommended by national guidelines to minimize additional morbidity/mortality, but limited evidence exists regarding the effect of intraoperative hypothermia on patients with hip fractures. The purpose of this study is to determine the incidence of intraoperative hypothermia in patients with hip fractures and evaluate the impact of hypothermia on complications and outcomes.

MATERIALS/METHODS: A retrospective chart review was performed of clinical records from 1,541 consecutive patients who sustained an intertrochanteric (IT) or femoral neck (FN) fracture and underwent operative fixation at our institution from January 2005 to October 2013. Ultimately 1,525 patients were included for analysis, excluding those with multiple injuries requiring additional surgical intervention. Chart review recorded patient demographic data, surgery-specific data, postoperative complications, length of stay, and 30-day readmission. Statistical analysis included non-normal distributed continuous variables analyzed by non-parametric Wilcoxon test. Categorical variables were examined using chi-squared tests. A p-value less than 0.05 was considered statistically significant. All statistical analysis was performed using SAS Version 9.3.

RESULTS: Overall incidence of intraoperative hypothermia in hip fracture was 13.2% (14.1% in IT fractures, and 11.7% in FN fractures). Hypothermia was associated with an increase in the rate of deep surgical site infection (DSSI) (p=0.031) for all hip fractures. No other significant findings were observed in regard to complications, length of stay, or 30-day re-admission. The rate of hypothermia when using an active re-warming device was 13.6%, 15.3%, and 11.6% for all hip fractures, IT, and FN fractures, respectively. For patients who experienced hypothermia despite the use of re-warming, a statistically significant increase in the rate of non-surgical site infection was identified (NSSI)(p=0.033).

DISCUSSION/CONCLUSIONS: The incidence of intraoperative hypothermia in hip fractures was 13.2% and the use of active re-warming devices does not necessarily correlate with intraoperative normothermia. In patients with hip fractures, hypothermia may be associated with increased risk of DSSI and hypothermia despite active re-warming may be associated with increased NSSI rates. This is the first study to our knowledge that specifically addresses intraoperative temperature monitoring in hip fracture patients.

Retrospective Analysis of the Impact of Day of Admission, Payer Type, and Disposition on Outcomes Following Hip Fracture Procedures

Abstract ID: Paper 035

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INTRODUCTION: Proximal femur fractures are among the leading diagnoses for hospital admissions in the elderly. In 2013, CMS made provisions to combat unnecessary expenditures and shorter hospital stays were presumed to be medically unnecessary. Medicare reimbursements require patients to stay at least two midnights during admission. While efforts intend to eliminate economic waste associated with fraud, imposing a 3-day requirement may still have financial waste. Patients with proximal femur fractures, that could be discharged sooner, have hospital admissions with longer length of stay and higher costs. This study investigates the impact of insurance type, in combination with day of admission and place of discharge, on hospital length of stay and financial outcomes for patients admitted for a hip fracture.

METHODS: This is a retrospective review of patients treated for proximal femur fractures at a level 1 trauma center from April 2011 to April 2013. High impact trauma patients were excluded. Groups were separated based on day of admission, type of insurance (Medicare vs. other), and location following disposition (skilled nursing facility [SNF], home, home health). Regression analysis was used to assess length of stay (LOS), cost, and charge. Data is expressed as means to determine statistical significance ($p<.05$).

RESULTS: 508 patients met inclusion criteria. The average age was 81.6 years, with 381 females and 127 males. There was no statistically significant independent correlation between outcome and day of admission. Type of insurance showed a statistically significant longer LOS for Medicare patients compared to other payers (mean of 5.71 vs. 4.48 days, respectively; $p=0.0297$). Medicare patients also had 15% higher cost ($p=0.0486$) and charge (percentage, $p=0.0585$) associated with their admission. All outcomes were significantly higher for patients discharged to a SNF. There was also statistical significance for all outcomes with a combination of all three variables ($p=0.0034$). Disposition had the greatest impact on statistical significance.

CONCLUSION: Hip fractures are an emergent injury with unplanned admission. Several factors impact the economic burden translated to hospitals. Our results show a correlation between LOS, cost and charge, with a combination-model of day of admission, type of insurance, and discharge destination. Medicare patients and patients discharged to a SNF have longer hospital stay and higher cost and charges. Efforts to decrease expenditures remain a concern as adjustments are made to reimbursements for the growing Medicare population. A closer look at the '2-midnight benchmark' for Medicare patients may help improve outcomes and decrease expenditures.

The Interprosthetic Femur Fracture: Evaluation of the Stress Riser Effect, a Finite Element Analysis

Abstract ID: Paper 036

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PURPOSE: An increasing population now has ipsilateral total hip and knee arthroplasties, creating a more common scenario, the inter-prosthetic fracture. Many adhere to the principle that a 2-cortical diameter margin (CDM) must be left between implants to avoid a stress riser. This study aims to evaluate how varying CDM and bone density impacts the stress riser effect. The authors hypothesized that the fracture risk will change proportionally with changes in the CDM and will be greater for osteoporotic bone.

METHODS: A CT scan of a femur, a proximal femoral stem, and five distal femoral locking plates were modeled. Surfaces were converted into volumetric tetrahedral mesh using Salome. All simulations were completed in Abaqua CAE with 5 or 15Nm of torque applied, approximating internal/external rotation with normal gait. Plate length was altered to vary the CDM from -2 (overlapped) to 3. Simulations were completed using normal bone density (1.8 gm/cm^3 and varying osteoporotic bone densities (1.7 gm/cm^3= OP-Med; 1.6 gm/cm^3= OP-Hi). Maximal stress at the tip of the stem was obtained and used to calculate a percent fracture risk (%FR).

RESULTS: The 5 Nm/OP-Med simulation, the control (stem only) model, the %FR was 9%. Highest %FR (29%) was found when the plate was <1 CDM from the stem. With 2 or 3 CDM, the %FR was 6 and 8%. In the 1 and 2 CDM plate and stem overlap models, the %FR was 14% and 9%. This trend was present in all simulations at 5 and 15 Nm, with the greater the level of osteoporosis, the greater the %FR. At <1 CDM, there was a significant difference in %FR when OP-Hi models were compared to normal bone ($p<0.0001$) and OP-Med ($p<0.01$).

CONCLUSION: Our results were similar to the presumed gold standard of the 2 CDM being the minimal distance to not create a stress riser. At or greater than the 2 CDM, the calculated %FR was equal to or less than the control regardless of bone density. The highest %FR was noted when the CDM was <1. Overlap models reduced the %FR. At an overlap of greater than 2 CDM, the %FR was equal to that of the control. This suggests a 2 CDM of under- or overlap appears to eliminate the stress riser effect in the femur when treating interprosthetic fractures, and osteoporosis increases the stress riser effect, especially when within 1 CDM, proving to be a risk factor.

A Novel Method to Quantify Ankle Soft Tissue Envelope and Its Association With Surgical Site Infections After Open Reduction Internal Fixation of Unstable Ankle Fractures

Abstract ID: Paper 037

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BACKGROUND: Unstable ankle fractures are common injuries with the standard of care often involving open reduction internal fixation (ORIF). Unintended complications can arise, specifically surgical site infections (SSI), which can impact patient quality of life, functional outcomes, and healthcare costs. The soft tissue envelope (STE) size may alter the patient's risk for SSI and ability to heal. No association between STE or Body Mass Index (BMI) and ankle SSI after ORIF has been demonstrated. The purpose of our study was to examine the association between STE and SSI following ankle ORIF, as well as identify other risk factors.

METHODS: A retrospective review was conducted of 499 patients who underwent ankle ORIF at a single institution. Patient, injury, and treatment specific risk factors were retrieved. Novel radiographic measurements of STE and Tibial Cortical Diameter (TCD) were performed at the time of injury, 3 months, and 6 months postoperatively. Relative ratio (RR) of STE to TCD served as an internal control for magnification variability, and Intraclass Correlation Coefficient (ICC) was calculated for observer reliabilities.

RESULTS: STE size was significantly larger in the infected cohort. At the time of injury, the coronal measurement showed significant difference: 49/1 vs. 45/1 ($p=0.22$). At 3 and 6 months, coronal, sagittal, and cumulative STE were all significantly greater in the infected cohort: 47.4 vs. 40.9 at 3 months ($p=0.003$), and 49.7 vs. 40.0 at 6 months ($p<0.001$). Similarly, the infection group demonstrated significant STE:TCD ratios postoperatively: 1.4 vs. 1.3 ($p=0.045$) and 1.5 vs. 1.3 ($p=0.003$). Other demonstrable risk factors included diabetes, hypertension, coronary artery disease, peripheral vascular disease, and longer mean surgical time. Interestingly, BMI did not show statistical significance.

CONCLUSION: We describe a novel measurement tool for evaluating ankle STE, suggesting its size is a significant risk factor for developing SSI. Significance in all measurements was seen at 3 and 6 months with corresponding relative ratios. However, only measurements in the coronal plane at the time of injury showed significance, despite wide variability in radiographic quality. With more consistent radiographic technique at follow-up, all the 3 and 6 month measurements showed reliable results, and the ICC revealed strong reliability. Our study underlines the strong associations between SSI and immunocompromised and vasculopathic states; supports the value of a healthy ankle soft tissue envelope when considering surgery; and this novel tool allows surgeons to better counsel patients on their risk of developing a surgical site infection.

Fixation of Medial Malleolar Fractures: A Clinical and Radiographic Comparison of Unicortical Partially Threaded Lag Screws and Unicortical Fully Threaded Neutralization Screws

Abstract ID: Paper 038

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PURPOSE: Multiple techniques have been described for operative fixation of medial malleolus fractures. The use of two partially threaded (PT) cancellous lag screws is a widely accepted technique. A technique which has not been extensively studied is fixation with two unicortical fully threaded (FT) 3.5 mm neutralization screws. The purpose of this study is twofold: (1) to report the clinical outcomes of patients treated with two unicortical fully threaded (FT) 3.5 mm neutralization screws; and (2) to compare these outcomes with patients treated with, the more standard, partially threaded 4.0 mm cancellous lag screws. The null hypothesis was that unicortical PT lag screws and unicortical FT neutralization screws had similar clinical outcomes.

DESIGN: Retrospective cohort series with control. Setting – Level 1 trauma center.

PATIENTS: A database was created to include all ankle fractures treated operatively at this institution from January 1, 2007 – December 31, 2012. A total of 472 patients were identified. Fifty-two patients had no fixation of the medial malleolus fracture and were excluded and 160 patients treated using different methods of fixation were also excluded. This left 260 patients with an ankle fracture treated with either two PT or two FT screws; 100 patients with open fractures and/or inadequate follow-up were then excluded leaving 77 patients eligible for inclusion in the PT group and 83 patients in the FT group.

INTERVENTION: Either two traditional 4.0 mm PT cancellous screws (n=77) or two 3.5 mm FT neutralization screws (n=83) were used for fixation of the medial malleolus fracture.

OUTCOME MEASUREMENTS: Radiographic evidence of screw loosening, nonunion, and removal of hardware.

RESULTS: Radiographic screw loosening was evident in 5 of the 77 patients in the PT cohort (6.5%) and in 0 of the 83 patients in the FT cohort, $p = 0.024$. All patients in the FT cohort healed after the index procedure, while 4 patients in the PT cohort had nonunions (5.2%), $p=0.051$. In the PT cohort, 15 patients required reoperation for removal of symptomatic hardware (19.5%), while 5 patients in the FT cohort required removal (6.0%), $p=0.015$.

CONCLUSIONS: Fixation of medial malleolus fractures using two 3.5 mm fully threaded neutralization screws has significantly lower rates of screw loosening and lower rates of reoperation when compared with fixation using two 4.0 mm PT screws. There was no significant difference found in union rate, although there were no instances of nonunion in the FT cohort.

A Radiographic Zone-Based Approach to Predict Meniscus Injury in Lateral Tibial Plateau Fracture

Abstract ID: Paper 039

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INTRODUCTION: There is limited data regarding meniscal injury and its association to fracture location and articular impaction/displacement (AID) in tibial plateau fractures. The purpose of this study was to predict lateral meniscal injury in tibial plateau fractures, based on location and extent of AID as visualized on preoperative CT images.

METHODS: We retrospectively reviewed lateral tibia plateau fracture patients that were treated operatively. All patients had an arthrotomy at the time of surgery to evaluate the integrity of the meniscus. The injured lateral tibial plateau was divided into four quadrants on preoperative CT and maximum AID was measured. The zone of fracture was defined as the location of largest AID (Image-1). Intraoperative data regarding meniscal integrity and preoperative CT data were analyzed. Logistic regression was used to estimate what effect zone and amount of AID had on predicting the meniscal injury. Receiver operating characteristic (ROC) analysis was performed to determine cut-off points for high sensitivity/specificity.

RESULTS: 70 patients were included in the study. Mean age was (45.1±12.9) years. Twelve had Schatzker type I and 58 had type II fractures. Twenty-two patients had meniscus injury (MI) and 48 patients did not have a meniscus injury (NMI). Mean AID for MI was 12.48 mm±7.17 mm and 6.4 mm±4.3 mm for NMI ($p<0.01$). In MI group, largest AID was in zone 3 (17.58 mm±8.9 mm) followed by zone 2 (13.3 mm±7.2 mm) and zone 1 (9.4 mm± 5.8mm). In NMI group, largest AID was in zone 1(8.52 mm±2.6 mm) followed by zone 2 (8.04 mm± 5.4 mm) and zone 3 (7.75 mm±2.35 mm). Patients with zone 3 involvement had a lower meniscus tear rate compared to other zones. Logistic regression revealed that for every 1 mm increase in AID, there is a 21% increase chance of meniscus tear ($p<0.01$). Comparison of the zones indicated that for the same AID, zone 1 and 2 fractures have 7.3 and 5.6 times increase risk of meniscus tear, respectively, as compared to zone 3 ($p<0.05$). ROC analysis revealed that AID of 4.3 mm as a cut off point provides 100% sensitivity for diagnosis of meniscus tear.

CONCLUSION: With 1 mm increase in AID, there is a 21% increase in chance of meniscal tear. With the same AID, zone 1 and 2 fractures have a significantly higher chance of having a meniscal tear. AID of 4.3 mm provides 100% sensitivity to predict meniscal tear in lateral tibia plateau fracture. These values are useful in predicting preoperative meniscal tear without MRI.

Click here to view Image

Does a Low Serum Vitamin D in Fracture Patients Matter?

Abstract ID: Paper 040

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PURPOSE: To determine if a low serum 25-OH vitamin D is associated with a higher complication rate in fracture patients.

METHODS: A retrospective review was done of all orthopedic trauma patients over 20 months to identify patients with an initial and repeat 25-hydroxy (OH) vitamin D serum level. During this time, the orthopedic trauma service's protocol was that all patients managed operatively had an initial 25-OH vitamin D level. Unless contraindicated, all patients received daily vitamin D3 and calcium replacement. Those that were found to be deficient or insufficient were also given a weekly high dose vitamin D2 for 8 weeks. Repeat serum 25-OH vitamin D levels were performed between 2 and 3 months after surgery. The cohorts were separated by initial serum 25-OH vitamin D level. The primary outcomes were fracture and wound healing. Only complications requiring surgical interventions were evaluated. T-tests, one-way ANOVA, and Fisher's Exact tests were used to determine statistical significance ($p<0.05$).

RESULTS: 201 patients were identified that had initial and repeat vitamin D levels. Out of 201 patients, 81 (40.3%) were initially deficient, 88 (43.8%) insufficient, and 32 were normal (15.9%). Therefore, 169/201 (84.1%) patients were considered to have a low initial serum 25-OH vitamin D level. 15/201 (7.5%) of patients required orthopedic procedures for fracture and wound healing complications, and 13/15 (87%) had a low initial vitamin D and 8/15 (53.3%) remained low after supplementation. Overall, however, there were no significant differences in serum 25-OH vitamin D levels between those patients that had fracture or wound healing complications (15/201) and those without complications (186/201) when comparing the initial vitamin D level (mean 22.5 ng/ml vs. 22.8; $p=0.92$, power) and the repeat level (mean 33.3 ng/ml vs. 32.9 ng/ml; $p=0.91$, power=0.8), respectively.

CONCLUSIONS: Although the prevalence of low vitamin D is high in orthopedic trauma patients, there doesn't appear to be a correlation between the initial and/or repeat serum 25-OH vitamin D level and risk of fracture or wound healing complications requiring surgical intervention.

Nonoperative vs. Operative Treatment of Diaphyseal Humerus Fractures: A Systematic Review

Abstract ID: Paper 041

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PURPOSE: To determine if there is a significant difference in clinical outcome scores, union rates, and radial nerve injuries between operative and nonoperative treatment of diaphyseal humerus fractures.

METHODS: This review was performed using PRISMA guidelines and registered with PROSPERO on December 6, 2013. Study inclusion criteria included any investigation published in English language, with a minimum of one-year follow-up that compared outcomes between operative and nonoperative treatment of diaphyseal humerus fractures in skeletally mature individuals. Exclusion criteria were investigations of skeletally immature patients, fractures not involving the humeral shaft, studies with less than one year follow-up, and level V evidence.

RESULTS: Nine studies were included for evaluation. Mean patient age was 39.4 +/- 1.31 years. Mean follow-up was 26.4 months. 486 fractures in 485 patients were included (64% male and 36% female; 69% closed and 17% open). 89.9% treated operatively (171 ORIF, 262 intramedullary nailing). There were 49 patients that were treated nonoperatively. There were 22 nonunions reported, (15 operatively-treated group, 5 nonoperatively-treated group). There were 6 malunions overall (3 operatively-treated group, 3 nonoperatively-treated group). There were 9 reported delayed unions all in the operatively-treated group. When the complications of nonunion, malunion, and delayed union were considered together, there were less complications in the operatively-treated group ($p=0.019$). There was no difference in the rate of complication between intramedullary nailing and open reduction internal fixation ($p=0.346$) or between intramedullary nailing and non-operative treatment ($p=0.086$). There was a significant difference between open reduction internal fixation and nonoperative treatment ($p=0.0057$). There were 108 radial nerve injuries with an overall mean recovery time of 6.1 months. There was no standardization to the reporting of functional outcome scores between studies.

CONCLUSIONS: Diaphyseal humerus fractures are common injuries that have been shown to be treated successfully both nonoperatively and operatively. There was a higher rate of nonunion in the nonoperatively-treated group while there was not difference in union rate between intramedullary nailing and open reduction internal fixation within the operative group. Of those radial nerve injuries that were explored at the time of surgery, the most common pathology was a traction injury. There is little standardized data to compare the functional outcomes of patients treated nonoperatively to those treated operatively. This review found that there needs to be more research performed in the area of functional outcomes for these fractures.

Extremity Fractures Associated With ATVs and Dirt Bikes: A Six-Year National Epidemiological Study

Abstract ID: Paper 042

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BACKGROND: All-terrain vehicle (ATV) and dirt bike use is increasing in the U.S. and is associated with significant risk of traumatic injury. Injury resulting from use of these vehicles is, unfortunately, common and range from minor to life threatening trauma. Although there is literature discussing traumatic head injuries, spine trauma and life threatening injuries, examinations of injuries to the extremities is limited. As use of off-road vehicles in the U.S. is on the rise, it is important to also understand the more common and less severe injuries associated with the activity. The purpose of this study is to examine patterns of extremity fractures associated with ATVs and dirt bikes. Results will show unique injury patterns associated with certain groups of riders and vehicle types due to patient demographics and to the inherent lack of vehicle stability.

METHODS: The National Electronic Injury Surveillance System (NEISS) was used to acquire data for extremity fractures related to ATV (3-wheels, 4-wheels, and number of wheels undefined) and dirt bike use from 2007-2012. Nationwide estimation of injury incidence was determined using NEISS weighted calculations.

RESULTS: The database yielded an estimate of 229,362 extremity fractures from 2007-2012. The incidence rates of extremity fractures associated with ATV and dirt bike use were 3.87 and 6.85 per 1000 vehicle-years. The largest proportion of all fractures occurred in the shoulder (27.2%), followed by the wrist and lower leg (13.8% and 12.4%, respectively). When comparing the specific injury locations for different vehicle types, there were no differences in the distribution of the location of fractures among 4-wheeled or unspecified ATVs. However, 3-wheeled ATVs and dirt bikes had much larger proportion of lower leg, foot, and ankle fractures compared to the other vehicle types.

CONCLUSIONS: While upper extremity fractures were the most commonly observed in this database, 3-wheeled ATVs and dirt bikes showed increased proportions of lower extremity fractures. As individual risk factors for certain fracture types are identified, it is essential to continue to develop injury prevention and safety strategies in addition to stricter legislation regarding the sale and use of such vehicles. Surveillance is imperative to our understanding of the epidemiologic basis for pediatric fractures associated with motorized dirt bike and ATV use. Such insight will help facilitate further research to develop injury prediction tools, address better vehicle design, and enact stricter safety standards.

Does Osteoporosis Intervention Decrease the Need for Additional Surgery in Femoral Neck Fractures Treated With Closed Reduction and Percutaneous Pinning?

Abstract ID: Paper 043

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INTRODUCTION: Femoral neck fractures are one of the most common injuries sustained in the elderly population. The worldwide incidence of hip fractures has been estimated to rise from 1.7 million in 1990 to 6.3 million by 2050. Femoral neck and pertrochanteric fractures will account for approximately 90% of these. Treatment of femoral neck fractures in patients over the age of 65 is largely determined on fracture displacement. Minimally displaced fractures can be treated with a less invasive approach consisting of closed reduction and percutaneous pinning (CRPP) or a fixed angle compression device. Revision surgery after CRPP in older adults has been reported up to 17%. The purpose of this study was to evaluate the need for secondary surgery in patients who received comprehensive osteoporosis evaluation and individualized intervention as compared to those who did not.

METHODS: A convenience sample of 151 patients over the age of 65 years with nondisplaced femoral neck fractures treated with CRPP were identified using Current Procedural Terminology codes from June 2006-September 2013 at a Level 1 trauma center. Nineteen were excluded due to follow-up less than one year, leaving a study sample of 132 patients (30 males, 102 females), average age 81 (65-102) for a retrospective analysis. In the osteoporosis intervention group, 66 patients (50%) were evaluated by a bone health specialist including laboratory work (calcium and vitamin D levels, bone turnover makers, and DEXA scan) and treated while 66 patients (50%) in the control group were not evaluated.

RESULTS: Patient follow-up averaged 41 months (12-100). There were no differences in baseline demographics or osteoporosis intervention prior to fracture between the groups. All patients (100%) in the evaluation and intervention group had individualized osteoporosis treatment as compared to 8 patients (12.1%) who received some form of treatment in the control group ($p<0.001$). Osteoporosis intervention was statistically different between the groups in the use of calcium and vitamin D supplementation ($p=<0.001$), bisphosphonates ($p=0.029$), and Forteo ($p<0.001$). Surgical revision occurred in 11 (15.2%) for AVN/osteonecrosis (4, 36.4%), subsequent fracture (4, 36.4%), nonunion (2, 18.2%), and screw cutout (1, 9.1%). The revision rates were not different between the intervention (3, 4.5%) and control groups (8, 12.1%) ($p=0.103$).

CONCLUSION: While there were fewer revisions in the intervention group, comprehensive osteoporosis intervention in patients over 65 years old with minimally displaced femoral neck fractures treated with CRPP did not show a statistically significant decrease in the rate of secondary surgery.

MAOA BREAKOUT SESSION #4
HIP AND KNEE ARTHROPLASTY
April 14, 2016

Myocardial Cobalt Levels Are Elevated After Joint Arthroplasty and Associated With Cardiac Pathology

Abstract ID: Paper 044

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INTRODUCTION: Orthopedic joint implants commonly contain elemental metal that may undergo wear-related release. Recently, cases of implant-associated myocardial injury have been reported; however, we are not aware of any study that has systematically measured myocardial metal levels or examined the relationship with arthroplasty.

METHODS: Archives of our institution's total joint registry and autopsy registry were cross-queried for autopsies of individuals that underwent hip, knee, or shoulder replacement with cobalt-chrome components (1990-2011). Eighty age- and sex-matched, non-arthroplasty controls were procured. Demography, implant type, and the presence of heart disease were abstracted from the medical record. Myocardial tissue samples were acid-digested using closed vessel microwave digestion, diluted with internal standards, and analyzed for cobalt (Co) and chromium (Cr) by inductively coupled plasma mass spectroscopy. Wilcoxon rank-sum, chi-square tests, and Kruskal-Wallis tests were used to assess differences between cohorts.

RESULTS: Ninety-four Co/Cr-on-polyethylene arthroplasty cases were included (mean age 77.4 years; 46.8% women). Baseline cardiac risk factors were statistically similar between groups. 77 (81.9%) cases had at least one hip replacement at the time of death. Significantly higher myocardial concentrations of Co were observed in individuals with arthroplasty compared to controls (median 0.105 vs. 0.077 µg/g, p=0.003). Median Co was 62% higher in hip patients that had undergone revision vs. no revision (p=0.008). In general, the highest Co levels were observed in those with multiple replaced joints. Cardiomegaly and fibrosis were observed more frequently in the postmortem samples of patients with implants (p=0.002 and p=0.025, respectively).

CONCLUSIONS: This is the first study to our knowledge that quantifies metal levels in cardiac tissue in patients with and without joint replacement. The correlation of elevated myocardial Co levels with cardiac pathology found during autopsy in the arthroplasty cohort is a novel finding. Additional study is needed to more fully characterize the clinical implications of this association.

Outcomes of Revision Surgery for Recalled Modular Neck Femoral Implants: A Two-Year Follow-Up

Abstract ID: Paper 045

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INTRODUCTION: Hip stems with modular necks were designed to provide more options for anatomic hip reconstruction. Adverse local tissue reactions related to the implant led to a voluntary recall and multiple revision operations, but there has been no major study of revision surgery outcomes in this population.

METHODS: A review of prospectively collected data was performed on 136 patients who underwent revision of a modular neck hip implant between May 2012 and May 2013, giving at least a 2-year follow-up on all patients. 110 patients were revised via direct lateral approach, 25 via postero-lateral, 1 via direct anterior approach. Operative reports and imaging data were reviewed and descriptive statistics performed.

RESULTS: 31.6% (43/136) patients required at least one re-operation after the initial revision surgery, and 8.1% (11/136) have required two or more re-operations. Of the 110 patients revised via direct lateral approach, 30 required re-operations (27.3%), with 18 of these operations for abductor necrosis, 5 for infection, and 2 for acetabular revision. Of the 18 patients with abductor deficiency, 11 required tensor-fascia lata to gluteus maximus muscle transfers on first reoperation and 4 required muscle transfer on second reoperation. An additional 15 of the 110 patients revised via direct lateral approach have abductor detachment on imaging, but have not yet undergone revision. Of the 25 patients revised via posterolateral approach, 2 (8.0%) required return to the OR for closed reduction of dislocations, with no evidence of abductor detachment. The one patient revised via direct anterior approach required revision for a trochanteric fracture.

CONCLUSION: There is a high rate of re-operation required after revision surgery for modular neck stem implants. We recommend using the posterolateral approach for the initial revision surgery, as we have noted an unacceptably high rate of abductor deficiency following revision with the direct lateral approach.

Retrospective Review of Trabecular Metal Femoral Stems in Total Hip Arthroplasty

Abstract ID: Paper 046

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BACKGROUND: Porous tantalum is a novel new product in total hip arthroplasty. The short- and long-term outcomes of cementless trabecular metal femoral stems have not been clearly elucidated in the literature. We retrospectively reviewed the outcomes of trabecular metal femoral stems utilizing clinical and radiographic analysis at six weeks and one year postoperatively to evaluate the rate of subsidence and need for revision surgery at our institution from 2007-2014.

METHODS: 290 primary total hip arthroplasty procedures were reviewed. Utilizing radiographs taken immediately postoperatively, at six weeks and at one year, the rate of subsidence of TM femoral implants was calculated. Harris hip scores were obtained for all patients and used to evaluate if there was a clinical correlation in patients with subsidence. Multiple systemic co-morbidities were assessed to evaluate for risk factors of subsidence.

RESULTS: 193 primary total hip arthroplasty procedures met our inclusion criteria. There was a 5.2% (10/193) rate of subsidence over the first year with one revision due to activity-related pain. There was an 8.8% (17/193) rate of intraoperative calcar fracture treated with cerclage wire. No patients with an intraoperative calcar fracture went on to subsidence within the first year. Multivariable logistic regression demonstrated increased odds of subsidence with increasing age and history of cancer.

CONCLUSION: The trabecular metal femoral stems have equivalent short-term outcomes compared to historical cemented controls. With predisposing factors like increased age and history of cancer, there is a higher risk of subsidence. If an intraoperative calcar fracture was noted and repaired with cerclage wire at the time of implantation, the rate of subsidence or revision did not increase.

LEVEL OF EVIDENCE: This is a level IV retrospective cohort study.

The Effect of Host Factors and Microbial Resistance in Two-Stage Reimplantation for Prosthetic Joint Infection - Long-Term Results

Abstract ID: Paper 047

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INTRODUCTION: Two-stage reimplantation has consistently yielded high rates of success for patients with chronic prosthetic joint infection, although long-term results are not commonly reported. The durability of such treatment may be influenced in the setting of resistant micro-organisms and the susceptible host. The purpose of this study is to determine the effect of host factors and micro-organism resistance patterns in the long-term success of two-stage reimplantation.

METHODS: A retrospective review was performed of all patients from a single institution treated with two-stage reimplantation for hip or knee prosthetic joint infection from 1990 to 2015. 117 two-stage reimplantations were performed in 114 patients. Intraoperative culture results at the time of explant and upon reimplantation were reviewed, along with comorbidities associated with infection. Patients without an identified pathogen were excluded. Host factors and resistance patterns in cultured organisms were observed with respect to implant failure. Regression analysis and Fisher's exact test were performed to interpret the data.

RESULTS: Mean follow-up was 10.2 years from the time of reimplantation surgery. Fourteen patients (14 joints) (11.9%) developed recurrent infection. Nine occurred early or within 2 years, and all but one were methicillin- or vancomycin-resistant pathogens (methicillin-resistant Staphylococcus aureus, methicillin-resistant Staphylococcus epidermidis, and vancomycin-resistant Enterococcus). Five infections were late hematogenous, occurring over 5 years after reimplantation, and all organisms (Streptococcus viridans, Serratia marcescens, Group G Streptococcus, Staphylococcus aureus, and Streptococcus pneumoniae) had normal resistance patterns. Early infections were more often caused by a resistant pathogen and late infections by a sensitive pathogen (p=0.003). All late infections involved a different organism than was isolated in the original infection. There was a trend toward higher risk of reinfection in the setting of renal disease (odds ratio [OR] 1.5), immunosuppression (OR 8.8), tobacco history (OR 1.1), and depression (OR 1.7). There was not, however, an increased risk in obese (OR 0.17) or diabetic (OR 0.8) patients. In these patients, resistant organisms occurred with higher incidence with diabetes (OR 2.9), renal disease (OR 1.2), obesity (OR 1.9), and tobacco history (OR 1.8).

DISCUSSION: Five year success at our institution was previously reported at 93.5%. This study provides important information regarding long-term results for two-stage reimplantation, which indicate the results may not be durable over the patient's lifetime. 35.7% (5 of 14) of reinfections occurred more than 5 years after reimplantation, and in all cases a different organism was isolated at the time of initial presentation. In contrast, in all but one early or delayed reinfection, the same resistant organism was isolated. These findings suggest a high rate of failure in clearing resistant infections and emphasize the need for research that may improve the host's ability to prevent infection.

Increased Femoral Head Offset is Associated With Increased Metal Ion Levels in Asymptomatic Patients With Cobalt Chromium on Polyethylene Total Hip Arthroplasty

Abstract ID: Paper 048

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INTRODUCTION: Total hip arthroplasty (THA) is a reliable and reproducible surgery. However, there have been increasing reports of adverse local tissue reactions (ALTRs) due to trunnionosis at the head-neck junction in patients with cobalt chromium on polyethylene (MOP) THAs. Predisposing factors for trunnionosis and elevated metal ion levels are currently unknown. Our two primary goals of this study were (1) to determine the serum metal ion levels in an asymptomatic MOP THA patient population, and (2) to determine if any implant- or patient-specific factors are associated with increased serum metal ion levels in these patients.

METHODS: We identified asymptomatic patients that were returning for 2-5 year postoperative follow-up for primary MOP THA. Patient implant information, serum metal ion levels, and functional outcomes were assessed. A student t-test was performed to compare means of continuous variables between groups as appropriate and a spearman's correlation coefficient was used to assess strength of association between variables. P-values < 0.05 were considered statistically significant.

RESULTS: Eighty patients were enrolled in the study. Femoral head sizes ranged from 32-44 mm, with a median of 36 mm. Increased femoral head offset was the only factor associated with increased serum metal ion levels. Mean Co level in the low femoral head offset cohort (1.5 mm or less) was 0.28 ppb and in the high offset cohort (>1.5 mm) was 0.87 ppb (p=0.03). Mean Cr level in the low femoral head offset cohort was 0.32 ppb and in the high offset cohort was 0.51 ppb (p=0.37). However, we noted a statistically significant increase in Cr levels when we compared a low offset cohort with a Cr level of 0.2 ppb (including -2 to 1 mm offset) to a very high femoral head offset cohort with a Cr level of 1.1 (+ 7 to 9 mm offset) (p=0.002). Mean Harris Hip Score for the cohort was 96.1 (range 71-100).

CONCLUSION: We identified the normal metal ion level in an asymptomatic MOP THA cohort to be approximately 0.2 ppb for both Co and Cr. Increasing femoral head size did not correlate with increasing metal ion levels; however, femoral head offset appears to be the main source of elevated level metal ion levels in MOP THA. We identified a significant increase in metal ion levels with increasing femoral head offset greater than 1.5 mm.

Contemporary Surgical Indications and Referral Trends in Revision Total Hip Arthroplasty: A 10-Year Review

Abstract ID: Paper 049

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INTRODUCTION: Revision total hip arthroplasty (THA) currently represents nearly 15% of all total hip arthroplasty performed in the United States. Given an increasing demand for primary THA, and a shift in the physician reimbursement model to a bundled payment system, a current characterization of the indications for revision THA is imperative. The purpose of our study is to summarize the indications for total hip arthroplasty revision surgery over the past ten years at a large, tertiary-referral academic medical center.

METHODS: Using our institution's joint arthroplasty registry, all patients undergoing revision THA surgery performed at our institution between May 2004 and September 2014 were retrospectively identified. Patient clinical charts and operative records were reviewed. Based on the findings, patients were assigned a primary indication for revision THA and up to two secondary indications. The duration between primary THA and revision surgery was determined.

RESULTS: Eight hundred and seventy consecutive revision hip arthroplasties were performed at our institution during the study period. There were 642 initial revisions of a primary THA and 238 repeat revision surgeries. Only 16.4% of revised hips had their index arthroplasty performed at our hospital while the majority of hips (83.6%) were referred to our institution. Aseptic loosening (31.3%), osteolysis (21.8%), and instability (21.4%) were the 3 most common indications for revision THA in our patient cohort. Metallosis represented 4.1% of all revision indications. Aseptic loosening, instability, and infection were the most common indications for revision surgery within 5 years of primary THA, while aseptic loosening and osteolysis were the most common indications for revision greater than 5 years from primary THA.

CONCLUSIONS: Aseptic loosening, osteolysis, and instability were the three most common indications for revision THA in our study. Infection and instability remain problematic within 5 years of primary THA. Although 4.1% of cases were revised for complications relating to metallosis, this represents a 400% increase compared to prior reports from before 2004. The large majority of our revision cases were referred in from outside institutions which highlights the transfer of a large portion of the revision THA burden to large, tertiary referral centers, a pattern which could be exacerbated under future bundled reimbursement structures. These findings help to predict future trends in revision THA surgery, which is especially important in light of the shift in health care towards Accountable Care Organizations and Bundled Payment Models.

Tranexamic Acid Reduces Blood Transfusions in Revision Total Hip Arthroplasty

Abstract ID: Paper 050

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INTRODUCTION: The use of tranexamic acid (TEA) can significantly reduce the need for allogenic blood transfusions in elective primary joint arthroplasty. Revision total hip arthroplasty may require increased utilization of postoperative blood transfusions for acute blood loss anemia compared to elective primary hip replacement. There is a limited literature to support the routine use of TEA in revision total hip replacement.

METHOD: We performed a retrospective review of 161 consecutive patients who underwent revision total hip arthroplasties from 2012-2014 at a single institution by two fellowship-trained surgeons. We compared the transfusion requirements and the postoperative hemoglobin drop of the TEA Group (109 patients, 114 hips) vs. the No TEA group (52 patients, 56 hips). Our standard protocol for administering TEA is 1000 mg of IV TEA at incision, and the same dose was repeated two hours later. The No TEA group did not receive the medication because of the hospital contraindication criteria.

RESULTS: The transfusion rate was significantly less for the TEA group (6%) compared to the No TEA group (34%) ($p \leq 0.002$). The postoperative drop in hemoglobin was also significantly less for the TEA group (2.02 gm/dL) compared to the No TEA group (3.53 gm/dL) ($p < 0.0001$). No adverse thromboembolic events occurred in the patients who received TEA.

CONCLUSION: The routine use of TEA during revision total hip arthroplasty demonstrated a significant reduction in allogenic blood transfusions. The postoperative hemoglobin drop was also significantly less with the use of TEA. We recommend the routine use of TEA during revision total hip arthroplasty.

The Results of Second Two-Stage Reimplantations for Periprosthetic Knee Infection

Abstract ID: Paper 052

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INTRODUCTION: Failed two-stage reimplantation with subsequent infection is a devastating outcome following two-stage exchange arthroplasty for periprosthetic knee infection. Attempts at further two-stage reimplantation procedures are fraught with difficulties without clear guidelines for treatment or prognosis. A staging system has been previously described in an attempt to stratify patients according to infection type, host status, and local soft tissue status. This system may prove useful when developing treatment algorithms for this difficult patient population. The purpose of this study was to report the results of subsequent two-stage reimplantation following a failed two-stage protocol for periprosthetic knee infection, as well as identify risk factors for failure, and complications associated with these procedures.

METHODS: We retrospectively identified 45 patients who underwent a second two-stage exchange arthroplasty for periprosthetic knee infection from 2000 to 2013. These patient's records were examined for outcome following these procedures, risk factors for failure, and complications. The minimum follow-up was 2 years (mean 6 years).

RESULTS: 22 (49%) patients underwent revision for infection with 28 (62%) patients undergoing revision for any reason. 20 of 22 (91%) patients revised for infection were classified as an immunocompromised host (B or C) and had a compromised local extremity grade (2 or 3). When isolating type A hosts, infection was eradicated in 7 out of 10 patients (70%). Recurrence of infection was diagnosed in 52% of medically compromised hosts (type B) and 75% of medically ill patients (type C) following a second two-stage reimplantation. 50% of medically ill patients (type C) had an amputation or resection arthroplasty at final follow-up. A constrained hinge prosthesis was used in 21 patients (47%) at the time of reimplantation, and metaphyseal fixation was utilized in 26 patients (58%). 14 of the patients (61%) free of revision were placed on lifelong antibiotic suppression. Of those patients not revised for infection, 9 (39%) had an extensor lag at final follow-up. 5 patients in the failure group underwent a third two-stage exchange arthroplasty following reinfection, with 3 out of 5 being infection-free at final follow-up.

CONCLUSION: This data suggests that expectations following a second two-stage exchange knee arthroplasty should be tempered as the failure rate of this procedure is high with considerable patient morbidity.

Patients Improve Substantially Less After Revision Total Knee Arthroplasty for Flexion Instability vs. Failures Related to Infection or Wear-Related Osteolysis

Abstract ID: Paper 053

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INTRODUCTION: Instability has emerged as the most common non-infectious cause necessitating early revision total knee arthroplasty. While studies have documented improvement in outcomes with revision for flexion instability, it remains unknown how these patient outcomes compare to patients revised for other failure etiologies. The purpose of this study was to compare functional outcomes after revision TKA based on the cause of failure.

METHODS: A retrospective review of our prospectively collected revision TKA database was performed on all patients who underwent revision TKA from 10/01/2010 to 1/30/2015. Demographic data and etiology of failure, along with preoperative and 4-week, 4-month, and 1-year Knee Society Scores (KSS) and EQ5D Index scores were obtained. Patients were grouped according to failure etiology and comparatively assessed for improvement in outcomes scores and patient satisfaction between groups. Statistical significance was considered $p<0.05$.

RESULTS: 136 consecutive revision TKAs were evaluated. To minimize confounding variables, knees revised with tumor or hinge-type prostheses, or associated with polypropylene-mesh extensor mechanism reconstruction were excluded from analysis, leaving 65 revision TKAs available. Categories of failure etiology were flexion instability (33.8%), infection (21.5%), aseptic loosening (24.6%), and wear-related osteolysis (10.8%). Objective, expectation, and function components of the KSS score improved more in knees revised for infection and wear/osteolysis, compared to flexion instability ($p<0.028$). Similarly, the mean EQ5D Index improved more in knee revised for infection and wear/osteolysis, compared to flexion instability ($p=0.017$).

CONCLUSION: Patients and surgeons can reliably expect improvement in functional and patient reported outcome measures after revision TKA for all diagnoses; however, revision for isolated flexion instability may only obtain modest improvement compared to other etiologies of TKA failure.

SIGNIFICANCE: Surgeons performing revision for isolated flexion instability should inform their patients that their degree of improvement measured with modern outcome metrics may be modest compared to their counterparts revised for infection and wear-related osteolysis.

A Novel System for Determining Clinically Relevant Loosening of Total Knee Arthroplasty Components

Abstract ID: Paper 054

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INTRODUCTION: There is limited data on evaluating aseptic loosening in total knee arthroplasty (TKA) and the significance of radiolucent lines on radiographs. The Knee Society's Roetgenographic Evaluation System (KSRES), the most established rating system, was developed when osteolysis, rather than implant debonding, was thought to be the most common mechanism for aseptic loosening. We sought to determine the sensitivity, specificity, and reliability of the KSRES system and compared these results to a new, simpler rating system to evaluate which system better identified component loosening in contemporary TKA.

METHODS: We retrospectively reviewed fluoroscopically enhanced images of 48 patients that underwent revision TKA. Stemmed and cementless implants were excluded. 21 patients were revised for aseptic loosening and 27 patients for other indications, most commonly instability. Component loosening was determined intraoperatively. The images were randomized and each reviewer independently used the KSRES to calculate a numerical score based on millimeters of radiolucent lines at implant interfaces; each tibial implant was categorized non-concerning (score 0-4), concerning (score 5-9), or impending failure (score >=10) as described by KSRES. We again randomized the images and each reviewer analyzed the images. Evaluating both the AP and lateral radiograph, the percent involvement of the tibial implant interface of any lucent line was determined and categorized as non-concerning (<10%), concerning (10-25%), or impending failure (>25%). We compared the specificity, sensitivity, and interobserver reliability of the two systems.

RESULTS: For the KSRES, the mean sensitivity for determining tibial component impending failure was 6% and mean specificity for determining a non-concerning implant was 96%. The reliability of grouping tibial components into one of the three specified categories was 73% (kappa =0.50, "moderate"). The new system for tibial grading significantly increased the sensitivity to 88% (p=0.005) while maintaining a specificity of 95% (p =0.9). Interobserver reliability increased to 90% (kappa =0.79, "good"). A greater than 25% radiographic lucency around an implant was a strong predictor for identifying an implant at risk for failure.

CONCLUSION: In an era of debonding as a primary cause of aseptic loosening in total knee arthroplasty, the KSRES significantly underestimates implant loosening. The new system described here demonstrated an excellent sensitivity, specificity, and interobserver reliability for determining clinical loosening of tibial implants in the modern era.

SUMMARY: A novel system for determining tibial component loosening based on percent involvement of radiolucent lines the implant interface, with 25% being a critical value, is highly sensitive and specific.

Periprosthetic Fractures of the Distal Femur: Is ORIF or Distal Femoral Replacement Superior?

Abstract ID: Paper 055

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INTRODUCTION: Periprosthetic distal femur fractures above a total knee arthroplasty (TKA) are becoming increasingly common. The available literature is limited with regards to the optimal surgical management strategy for these patients. The purpose of this study is to compare ORIF to distal femoral replacement (DFR) for treatment of these injuries.

METHODS: Following IRB approval, we identified 76 patients with a Type 2 periprosthetic distal femur fracture (displaced, components well-fixed), 53 of whom were treated with ORIF and 23 with DFR. Patients were evaluated clinically using the Knee Society Score (KSS) and radiographically for evidence of fracture union or implant loosening. All outcomes comparisons were adjusted for age, sex, and Charlson comorbidity index.

RESULTS: Demographics between the two groups were similar; however, patients treated with DFR had a higher mean Charlson comorbidity index (5.2 vs. 3.8; p =0.006). The mean postoperative KSS were 85.0 and 83.6 (p=0.746) and the mean functional scores were 41.9 and 52.3 (p=0.339) for the DFR and ORIF groups, respectively. 45 ORIF and 20 DFR patients had 2-year follow-up. Of these, 5 ORIF patients (11.1%) and 2 DFR patients (10.0%) underwent a reoperation (p=0.587; mean of 1.7 reoperations for ORIF patients and mean of 1.0 for DFR). 6 ORIF patients (13.3%) and 6 DFR patients (27.3%) died within two years (p=0.381).

CONCLUSION: Distal femoral replacement and ORIF showed similar outcomes with regards to Knee Society Scores, revision rate, and mortality rate following adjustment for demographic and comorbidity characteristics. However, the available sample size may have limited the ability to demonstrate any true differences in outcomes. Given the strikingly high mortality and the substantial risk of reoperation, additional studies are needed to determine optimal treatment options for patients with periprosthetic fractures of the distal femur.

The Outcome of Semi-Constrained Rotating-Platform Implants for Revision Total Knee Arthroplasty

Abstract ID: Paper 056

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INTRODUCTION: Semi–constrained total knee arthroplasty (TKA) implants are commonly utilized to provide additional stability in the revision setting. The increased constraint of these implants potentially transmits shear stresses to bone, cement, and implant interfaces. Rotating-platform (RP) implants have been hypothesized to reduce the transmission of shear stress created by increased constraint. While the outcomes of primary RP implants have been previously well published, there remains a relative paucity regarding their outcome in the revision setting. The purpose of this study was to evaluate the outcomes of semi-constrained RP implants in the revision setting.

METHODS: Utilizing our institution's Total Joint Registry, we reviewed all patients who underwent a revision TKA with a semi-constrained RP implant from January 2006 to December 2008. Forty-eight patients were reviewed, 52% of which were female. The predominant indication for revision was component loosening (31.3%), while staged reimplantation following prior infection (27.1%) was the second most common indication. The average patient age was 66.8 years (range, 43–88 years) and the average BMI was 33.1 (range, 22–49).

RESULTS: The mean duration of follow-up was 5.7 years (range 4–7.6 years). Repeat revisions were performed in 3 patients (6.25%), including 1 isolated femoral revision, 1 revision of all components, and 1 resection arthroplasty and antibiotic spacer placement. The 2- and 5-year survival rates were 98% and 96%, respectively. There was no evidence of periprosthetic osteolysis or tibial implant loosening at final follow-up. The mean Knee Society Clinical and Functional Scores improved from 49.8 to 84.6 and 47.9 to 60.5, respectively, at final follow-up. Eight-five percent of patients reported an improvement in their knee. The mean ROM improved from 77.7° preoperatively to 101.8°, with 90% of patients having greater than 90° ROM at final follow-up. Seventy-five percent of patients reported minimal or no pain at latest follow-up. No factors had a significant impact on complications, revision rates, or clinical outcomes.

CONCLUSION: The semi-constrained RP implant used in revision total knee arthroplasty has acceptable implant survival and functional outcomes in the mid-term follow-up period.

KEY WORDS: Rotating-platform, revision, total knee arthroplasty, semi-constrained

MAOA BREAKOUT SESSION #5
Tumor/Education/Other
April 14, 2016

Dedifferentiated Chondrosarcoma: Survival Analysis of 159 Cases from the SEER Database

Abstract ID: Paper 057

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INTRODUCTION: Dedifferentiated chondrosarcoma is a rare malignancy with a poor prognosis. Survival rates are noted to range from 0%-29% at five years. Current literature consists of mostly small series and quite limited with regard to specific factors affecting survival. The aim of this investigation is to analyze a national sampling of cases of dedifferentiated chondrosarcoma to examine survivorship characteristics with relation to patient and tumor characteristics, surgical treatment factors, and overall and disease-specific survival.

METHODS: A series of 159 patients were identified in our retrospective review of the Surveillance, Epidemiology, and End Results (SEER) database from 2001 to 2011. We excluded patients who had incomplete data with regard to tumor location, survival, and who were classified as both “dedifferentiated” and low grade (AJCC Stage 1) histology. Demographic and clinical characteristics, histological features and grade of the tumors, location and size of the tumors, surgical stage at the time of diagnosis, use of surgery and radiation treatment, and survival were recorded. Kaplan Meier analysis, as well as univariate and multivariate analysis, was performed to examine overall survival, disease specific survival, and prognostic factors.

RESULTS: Overall and disease specific survival for our patient cohort was 18% and 28%, respectively, at 5 years. Individuals with appendicular tumors tended towards a worse prognosis than individuals with axial, chest wall, and soft-tissue tumors. Patients with a primary chest wall tumor were 0.27 (95% CI: 0.10 - 0.77) times as likely to die from disease as those who had a primary lower extremity tumor (p=.01). Individuals with grade III or IV AJCC were more than twice as likely to die from disease at any given time compared to individuals with grade II AJCC (p=<.01). Those with larger tumors (i.e., >8 cm) were 2.17 (95% CI: 1.11-4.27) times more likely to die from disease at any given time than were individuals with small tumors (i.e., <= 8 cm). Individuals presenting with metastatic disease at diagnosis were 4.05 (95%CI; 2.25 - 7.29) times more likely to die from disease compared to those with localized disease (p < .001). Nineteen patients treated without surgical intervention had a significantly worse overall survival rate compared to the groups who had surgery (p<.01).

CONCLUSION: The overall prognosis of dedifferentiated chondrosarcoma remains poor. Tumor size >8 cm, metastases at diagnosis, primary tumor located to appendicular skeleton, and nonsurgical treatment are factors associated with a worse prognosis.

Outcome and Complications Following Free Fibula Reconstruction for Oncologic Limb Salvage

Abstract ID: Paper 059

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BACKGROUND: Following tumor resection, reconstructive surgeons are often left with large composite defects in a physiological poor host. In order to achieve limb salvage and provide the patient with a functional extremity, free fibula transfer has become the work-horse for reconstruction. In the traumatic setting these flaps are reliable; however, due to host factors, the use of vascularized fibulas is associated with a high complication rate following oncological reconstruction. The aim of this study was to review our experience with using free fibula reconstruction following an oncological resection in the extremities affecting (1) overall survivorship, (2) disease specific survival, (3) union of the fibula, and (4) and limb salvage.

METHODS: We reviewed the records of 64 cases of free fibula transfer performed for limb salvage following an oncological resection from 1992 and 2013. Disease free and overall survival were estimated using Kaplan Meier method. The cohort consisted of 35 males and 29 females; with a mean age at surgery of 21 years and a mean follow-up of 7 years. 59% of the tumors were located in the lower extremity.

RESULTS: The overall 5-, 10-, and 15-year survival was 87%, 74%, and 74%. In an analysis of risk factors for mortality, failure of limb salvage and tumor recurrence was associated with a worse overall survival. In regards to disease specific survival, the overall 5- and 10-year survival was 74% and 66%. First time union was observed in 75% of cases at a mean time to union of 10 months. The overall union rate was 98%, with only 1 patient requiring a revision of the fibula graft with a new free vascularized bone graft. Patients undergoing chemotherapy following the free-fibula graft were more likely (OR 3.3, P=0.09) and patients with a spanning locking plate construct were less likely (OR 0.54, P=0.30) to need an additional bone grafting procedure. The overall rate of limb salvage was 94%, with 4 patients requiring an amputation for local tumor recurrence (n=3) and infection (n=1).

CONCLUSION: The free-fibula is considered the work horse vascularized bone graft for extremity reconstruction in limb-salvage surgery. In the oncological setting, a repeat bone grafting procedure was common, and likely related to the patient undergoing chemotherapy; however, following this procedure, the fibula reliably heals. In addition to this, we advocated to supplement the fibula fixation with a spanning locking plate, as the added stability may increase the first time union rates.

Proximal Humerus Limb Salvage Using Reverse Total Shoulder Arthroplasty

Abstract ID: Paper 060

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BACKGROUND: Surgical treatment of neoplasms of the proximal humerus often requires an envelope of resection that includes the tendons of the rotator cuff. Multiple options for limb salvage have been described; however, functional outcomes following treatment with traditional endoprostheses are limited by dependence on rotator cuff function. Reverse total shoulder arthroplasty relies primarily on deltoid function, allowing for a wider envelope of resection. It has demonstrated effectiveness in treating osteoarthritis as well as acute fracture of the proximal humerus in the setting of an incompetent rotator cuff. Limited early studies of reverse total shoulder arthroplasty following wide resection of the proximal humerus have also yielded favorable results. This is a retrospective case series of 11 patients with proximal humerus neoplasms, treated with wide resection of the proximal humerus followed by reverse total shoulder arthroplasty.

METHODS: A total of 11 patients (6 men and 5 women) underwent wide proximal humerus resection followed by reverse total shoulder arthroplasty. Patients were included if they were older than 18 years old, had a predicted survival of > 3 months, and were deemed at high risk for intramedullary nailing. Pathology was a combination of primary bone tumors (2/11) as well as metastases (9/11). All were performed as a single (non-staged) procedure using a standard reverse shoulder replacement. Humeral components were fixed with gentamicin cement and 3 patients received allograft augmentation. Follow-up ranged from 4 to 51 months. The primary outcome measure was defined as re-operation rate at intermediate follow-up. Secondary measures included patient survival, disease progression, and functional status, as measured by a simple shoulder examination and MSTS.

RESULTS: 7 of 11 patients survived to intermediate follow-up (defined, for the purposes of this study, as 12 months beyond the initial surgery) and 1 required re-operation prior to intermediate follow-up. Three patients suffered disease progression (1 early and 2 late). Simple shoulder examination was performed on 8 patients. Mean active ROM on simple shoulder exam was 11.4° external rotation (range 0 to 50), 83.6° forward flexion (range 50 to 120), and 87.1° abduction (range 75 to 110). Mean MSTS was 26.9 (range 23-30).

CONCLUSIONS: Reverse total shoulder arthroplasty is a valid reconstructive option following wide resection of the proximal humerus.

An Evaluation of Extraosseous Compared to Conventional Osteosarcoma of the Upper Extremity in the Modern Era

Abstract ID: Paper 061

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BACKGROUND: Extraosseous osteosarcomas are tumors histologically indistinguishable from conventional osteosarcoma but without the involvement of bone or periosteum. Due to their rarity, there is no published literature evaluating treatment options when these occur in the upper extremity. The purpose of this study was to evaluate our experience with extraosseous osteosarcoma of the upper extremity in the modern era and compare this to conventional osteosarcoma from the same period as a point of reference.

METHODS: After IRB approval, we reviewed the records of 43 patients with a diagnosis of either conventional or extraosseous osteosarcoma of the upper extremity treated surgically at our institution from 1992 - 2014. Of these, 14 (33%) were extraosseous and 29 (67%) were conventional osteosarcomas. There was a male predominance (86%) in the extraosseous cohort. The mean age was older (51 years) for the extraosseous when compared to the conventional osteosarcoma patients (27 years). Follow-up averaged 129 months.

RESULTS: The proximal humerus and shoulder girdle were the most common location for tumors in both cohorts. Most tumors were > 5 cm and all were high grade. There was no significant difference in the 2- and 5-year recurrence-free or overall survival between the cohorts ($p>0.05$). Most patients (93% extraosseous; 90% conventional) underwent a wide excision. Similarly, most (71% extraosseous; 83% conventional) received a limb-sparing procedure. There was a statistically significant increase in patients requiring an amputation as the definitive surgical procedure if they had undergone a previous inadvertent resection (OR 6.0; 1.1 - 32.1) ($p = 0.04$). Postoperative complications were more frequently seen in the conventional (38%) vs. extraosseous cohort (14%). Construct failure was the most common complication in the conventional osteosarcoma cohort. Nine patients (82%) who developed a complication in the conventional cohort required an additional procedure, including revision of the construct or free-tissue transfers.

DISCUSSION: We found that extraosseous osteosarcoma of the upper extremity is poorly responsive to adjuvant therapy, and treatment is reliant on resection. Most patients that undergo resection are able to undergo wide excision of the tumor with a limb-sparing approach. Inadvertent excision places patients at an increased risk of amputation during their definitive treatment. Multiple complications were seen in both cohorts with a large number of construct failures in the conventional osteosarcoma cohort. These patients frequently require revision surgery and our group has increased the use of vascularized fibula grafts and flap coverage to address these issues.

Body Mass Index and Unconscious Bias in Limb-Salvage Rates Among Pediatric Sarcoma Patients

Abstract ID: Paper 062

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INTRODUCTION: Disparities in limb-salvage surgery have been reported among adult sarcoma patients. This may include unconscious bias towards amputation. The purpose of this study was to explore how body mass index affects treatment patterns in a cohort of pediatric sarcoma patients.

METHODS: A retrospective review was conducted of all consecutive patients under the age of 18 treated for sarcoma at the study institution with diagnoses from 1999 to 2012 who underwent surgery for limb salvage or amputation. Statistical analysis of patient body mass indices at time of diagnosis was performed to assess for factors associated with limb salvage surgery.

RESULTS: Fifty-one records were identified as pediatric patients who underwent surgery for extremity sarcoma in the defined study period. Thirteen records were excluded due to inadequate availability of body mass index, body site, or surgery type documentation, leaving a cohort of 38 patients. The rates of limb salvage among those whose BMI was 85th percentile or greater was approximately 15%, vs. those with a normal BMI being 48%. Those patients who were overweight or obese were more likely to undergo amputation (11 of 13) compared to those with normal BMI (13 of 25) with odds ratio of 5.08 (CI [0.92, 27.8]). Conversely, while those with normal BMI had approximately equal chance at receiving limb salvage vs. amputation, those with elevated BMI were less likely to receive limb salvage with odds ratio of 0.20 (CI 0.03, 1.08).

CONCLUSIONS: Our pilot data suggests that body mass index appears to be a predictor of amputation in a cohort of pediatric sarcoma patients undergoing surgical treatment, and could potentially benefit by expanding the study to other centers. Further research should be devoted to elucidating unconscious bias as a contributing factor for amputation over limb salvage as it pertains to body mass index among pediatric sarcoma patients.

Factors Influencing the Number of Applications to Orthopedic Surgery Residency Programs

Abstract ID: Paper 063

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INTRODUCTION: The number of U.S. and Canadian applicants to orthopedic surgery residency programs increased by 25% (from 901 to 1,140) while the number of applications submitted per applicant rose 69% (40.6 to 70.2) from 2002 to 2014. The net result is an increase in number of applications received per program of 109% (248.9 to 519.5). This has increased the financial and time strain for both applicants and residency programs. We embarked on this study in an effort to identify factors that contributed to this large increase in applications to orthopedic surgery residency programs. We hypothesized that less qualified applicants (non-Alpha Omega Alpha [AOA] status, lower United States Medical Licensing Examination [USMLE] scores, fewer publications, less than honors in medicine/surgery clerkships) apply to a greater number of programs.

METHODS: This study was deemed exempt by our institutional review board. An anonymous questionnaire was sent to all applicants to our orthopedic surgery residency program for the 2015 match. Of 733 anonymous electronic surveys sent via SurveyMonkey, 140 (19.1%) responses were obtained (116 male, 24 female). Tests for significance were determined using one-way ANOVA with adjustments for unequal variances, non-normality, and low counts.

RESULTS: Statistically significant factors determining an increased number of applications sent per applicant included: applicant’s perception of how competitive they were ('average' perception submitted more applications than either 'good' or 'outstanding', p=.001) and number of away rotations (those who completed >2 away rotations submitted more applications, p=.03). No other factors questioned correlated with an increased number of applications submitted.

CONCLUSION: Less qualified candidates are not applying to significantly more programs than their more qualified counterparts. Only candidates’ own perception of being an average candidate and greater than 2 away rotations completed were associated with significantly more applications per applicant. Candidates are applying to an increasingly large volume of residency programs, irrespective of qualifications. This represents a financial strain on the applicant given the costs required to apply to increasing numbers of programs, and a time burden on individual programs to screen increasing numbers of applications. In order to stabilize or reverse this alarming trend, orthopedic surgery residency programs should openly disclose admission criteria to prospective candidates, and medical schools should provide additional guidance for candidates in this process. Specifically, medical schools should discourage individuals early in the process who are unlikely to match.

Investigating the Role of Personality-Based Behavioural Assessments in the Orthopedic Residency Match Process

Abstract ID: Paper 064

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INTRODUCTION: The incorporation of personality and behavioural evaluations in the hiring process for fields outside of medicine has proven successful. Recently, there has been increased interest in incorporating such assessments in the selection process for residency applicants. The purpose of this study was to determine the utility of incorporating a personality-based behavioural assessment in the selection of applicants for orthopedic residency programs.

METHODS: During the 2013-2014 orthopedic surgery residency application cycle, applicants interviewing at 10 orthopedic residency programs completed personality-based behavioural assessments developed specifically for the medical community. The assessment included 28 scales, measuring day-to-day interpersonal behavioural characteristics (HPI scales), stress-related behavioural tendencies (HDS scales), and key values that motivate the individual (MVPI scales). Concurrently, department chairs, programs directors, and orthopedic faculty from 12 ACGME accredited programs completed a job analysis survey to establish the “ideal profile” of an orthopedic resident. Tukey post hoc analysis was performed on each of the 28 scales to compare job analysis data to applicant data to determine how well the applicant population fit the established profile.

RESULTS: A total of 332 applicants and 175 faculty members completed the behavioural assessments. On 9 of 28 scales, applicants (n=332) did not show significant differences ($p>0.05$) when compared to the “ideal profile” established by orthopedic experts (n=175). Thus, for these 9 scales (Adjustment, Ambition, Sensitivity, Aesthetic, Affiliation, Commercial, Security, Altruistic, Hedonistic), applicants matched the “ideal profile”. On 19 of 28 scales, applicants did show significant differences ($p<0.05$) when compared to the “ideal profile”. Thus, for these 17 scales (Sociability, Prudence, Inquisitive, Learning Approach, Excitable, Skeptical, Cautious, Reserved, Leisurely, Bold, Mischievous, Colorful, Imaginative, Diligent, Dutiful, Recognition, Power, Tradition, Science), applicants failed to match the “ideal profile”. Applicants best fit the “ideal profile” on the MVPI scales (6 of 10). They least fit the “ideal profile” on the HDS scales (0 of 11).

CONCLUSIONS: Applicants showed evidence of matching certain aspects of the “ideal profile” of an orthopedic resident. Individual evaluation of medical students’ personalities and behavioural tendencies during the match process may allow for identification of applicants who have the best overall fit with the profile of an individual program. A formal personality-based behavioural assessment could be a useful tool in the orthopedic residency match process by allowing some insight into the affective domain of an applicant. Further studies and data assessment to include correlation with USMLE board scores and resident performance are necessary and underway.

Development of a Comprehensive Orthopedic Surgical Skills Curriculum

Abstract ID: Paper 065

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INTRODUCTION: The American Board of Orthopaedic Surgery (ABOS) and the Residency Review Committee for Orthopaedic Surgery (RRC) have both expressed interest and suggested residency programs to develop basic surgical skills programs with little guidance in their curriculum. This provides the opportunity to innovate in the development of these resident experiences. This work presents the initial experience from a mid-sized university/community hybrid program.

METHODS: Beginning in 2013, the RRC required programs to institute a basic skills curriculum which was initially accomplished at our institution through partnerships with industry. In 2014, this was identified as inadequate, and a push was made to develop a surgical skills laboratory with a less than $40,000 budget. As the PGY-1 curriculum was developed, we partnered with industry to provide advanced technology and large wet lab space to reduce the burden on our program for funding and resources.

RESULTS: Our program instituted the ABOS PGY-1 surgical modules in a longitudinal style curriculum. Several authors have described a surgical skills month; however, because of the structure of this program, having sufficient faculty time and availability of the residents for an entire month was not possible. The curriculum was structured weekly which allowed for demonstration, observed practice, and then independent practice over the week. The next week assessments were completed and then followed by remediation, if needed. Subsequently, a new module was introduced. Depending on the complexity of the modules, additional weeks were added as necessary. In the PGY 2-5 years, basic and advanced arthroscopy modules, upper and lower extremity fracture modules, a foot and ankle module, and a hand/microvascular surgery module were developed to maximize opportunities available to residents within the capabilities of the program and facilities available from industry. In these modules, junior residents act as learners and senior residents as instructors and evaluators.

CONCLUSION: Development of a comprehensive surgical skills curriculum remains daunting for many programs, especially with limited resources. Our experience shows that it is possible and beneficial for mid-sized programs with limitations in funding and facilities. Future directions include identification of assessment metrics and impact on resident educational experience.

Orthopedic Surgery Applicants: What They Want and How They Are Influenced by Post-Interview Contact

Abstract ID: Paper 066

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INTRODUCTION: Common strategies for orthopedic surgery residency programs to attract competitive applicants include optimizing the interview day and contacting favorably-ranked applicants post-interview. The purpose of this work was to determine (1) applicants' perspectives on the ideal interview day, (2) how frequently applicants are contacted post interview, and (3) the influence of this contact on their rank order list (ROL).

METHODS: A survey was sent to 1,091 orthopedic surgery residency applicants following the 2015 match regarding their views of the ideal interview day, what components they valued most, if they contacted programs following the interview, if programs contacted them, and how that contact impacted their ROL. All responses were collected and analyzed in an anonymous fashion, and all analysis was performed using data from applicants who successfully matched into a U.S. Orthopedic Surgery Residency.

RESULTS: Of the 408 applicants (37% response rate) who completed the survey, 312 (76%) successfully matched. Amongst many things, applicants stated they preferred: each interview to last 15 (55%) or 20 (33%) minutes, a mean of 1.7 (range 1-5) interviewers present for each interview, a total of 5 interviews (range 1-10) in an interview day, a formal interview with residents (96%), and the interview day to last only a half day (88%). The vast majority (94%) preferred a social event the night prior, and 54% wanted only residents to attend while 46% wanted both staff surgeons and residents present. A minority wanted an assessment of surgical skills (36%) or orthopedic knowledge (23%). The interview day was rated very valuable in determining their ROL (4.4 out of 5.0). Meeting or interviewing with the program director (4.1 of 5.0), meeting or interviewing with the chair (3.5 of 5.0), and the social event (3.4 of 5.0) were all rated as highly valuable components of the interview day. Applicants told a mean of 1.7 (range 0-11) programs they were "ranking the program highly" and 0.8 (range 0-5) programs they were "going to rank them #1." Of the 116 (40%) applicants contacted by programs following an interview, 83 (72%) stated that this had no influence on their ROL while 24 (21%) moved programs higher and 3 (3%) moved programs lower on their ROL following this contact.

CONCLUSIONS: Orthopedic surgery applicants very clearly have preferences for what they consider to be the ideal interview day and this data may be beneficial to programs looking to attract competitive applicants. Twenty-one percent of applicants ranked programs higher due to post interview contact. Interestingly, some applicants told as many as 11 programs that they were ranking them highly and up to 5 programs that they were ranking them #1.

The Efficacy of Arthroscopic Teaching Methods: A Prospective Randomized Controlled Study

Abstract ID: Paper 067

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PURPOSE: Arthroscopic education research recently has been focused on the use of skills labs to facilitate resident education and objective measure development to gauge technical skill. This study aimed to evaluate the effectiveness of hands on, hands off, and simple lecture based teaching on technical skills development in arthroscopic novices using an objective cadaveric knee examination and the number of 'look downs.'

METHODS: After IRB approval, 36 students were randomized into 1 of 3 groups. The first group received only a 25-minute lecture. The second group received the same lecture and 28 minutes of hands off arthroscopy instruction. The final group received the lecture and 7 minutes of hands on arthroscopy instruction. The knee examination, a 7 item task specific checklist, was graded by a single blinded examiner, and a separate blinded examiner judged the number of look downs. A post-test was given to all study subjects.

RESULTS: The Instruction group completed an average of 4.25 tasks (39.4 look downs), the Hands Off group completed an average of 5.0 tasks (42.3 look downs), and the Hands On group completed an average of 5.0 tasks with 32.6 look downs. The number of look downs and the number of tasks completed did not achieve statistical significance between groups. Survey results revealed that the Hands On group placed significantly more value on their educational experience as compared to the other two groups.

CONCLUSIONS: Contrary to our belief that the Hands On group would fare better, this study suggests that all three types of education have a similar impact on technical skills development. Future surgical skills curriculum should incorporate a variety of techniques that involve focused instruction teach to basic arthroscopy skills to new residents.

Level of Evidence: Level 1
Keywords: Arthroscopy, Arthroscopic skills, Residency Education, Teaching Curriculum

The Electronic Medical Record: Does It Accurately Reflect the Trauma Patient?

Abstract ID: Paper 068

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INTRODUCTION: The Electronic Medical Record (EMR) is standard in institutions. While there is not concern for legibility of notes and access to charts, there is an ease of copy and paste for daily notes. This may not lead to accurate portrayal of patient's status. Our purpose was to evaluate the use of copy-and-paste functions in daily notes of patients with injuries at high risk for complications.

METHODS: IRB approval was obtained for a retrospective review. Inclusion criteria included patients aged 18 and older treated at our Level 1 Trauma Center after implementation of Epic Systems. Those who were surgically treated for bicondylar tibial plateau fracture, or open tibial shaft fracture type I or II. Manual comparison of daily progress to the previous day's note was carried out. Comparisons were made by evaluating the Subjective, Objective, and Plan portions of the notes, coded nominally using 1 for a change 0 for remaining the same.

RESULTS: There were 38 patients charts reviewed during a 10-month (July 2012 – April 2013) period, average length of stay was 12 days (range: 2-35). A total of 418 notes were compared. The overall average of copied data was 85% daily. In the subjective portion, 85-97% of the data was copied on a daily basis and 71-92% of the data was copied within the objective portion of the notes. There were 15 medical complications necessitating intervention. Of these medical complications, the note the day after the complication reflected the event in 10 out of 15, or 70%, of the complications. Thus 5, or 30%, of the patients did not have notes reflecting the complication ($p<0.05$). There were 7 complications related to the injuries: 4 cases of compartment syndrome, 1 case of foot drop, representing a change in neurologic status, an amputation, and a wound infection treated with antibiotics. Four of the 7 complications (57%) were not reflected in the notes the following day after the complication ($p<0.05$). There were 54 planned returns to the operating room for procedures, yet 30 of the 54 (56%) notes regarding planned surgical procedures notes did not accurately report the plan for surgery ($p<0.05$). There were 4 patients with unplanned trips to the operating room and 3 of the notes (75%) did not reflect this ($p<0.05$). Twelve patients (32%) did not have notes accurately reflecting discharge plans and/or destination ($p<0.05$).

DISCUSSION/CONCLUSION: Our results demonstrated widespread use of copy and paste function. We encourage evaluation of the charts by comparing notes to check and a plan to minimize this practice. There needs to be consistent note writing guidelines and appropriate templates used. This will decrease the inaccuracies in the chart and provide a clear picture of the patient, their injuries, and current status.

Do Treatment and Outcomes of Proximal Humerus Fractures Differ Between Medicaid Patients and Privately Insured Individuals?

Abstract ID: Paper 069

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INTRODUCTION: As Medicaid expands due to the Affordable Care Act, a greater proportion of Americans will depend on this healthcare insurance. Traditionally, Medicaid has had lower reimbursement rates than private insurance providers, which can negatively impact physicians and hospitals. Because of this growing population, it is imperative that we understand how Medicaid status influences treatment choice and outcomes now and in the future. Previous studies have highlighted a negative impact on outcomes for Medicaid patients undergoing total knee replacements; however, little is known regarding traumatic injuries. The purpose of this study is to examine how payer status influences complication rates and outcomes for patients treated for proximal humerus fractures.

METHODS: All proximal humerus fractures from 2002-2012 were identified in the National Inpatient Database. In addition to treatment method, complication rates (CR), in hospital mortality (IHM), length of stay (LOS), non-routine discharge (NRD), and total hospital costs (THC) were collected and analyzed for each payer group (Medicare, Medicaid, private insurance [PI] and self-pay [SP]). Analysis of variance (ANOVA) tests were used to evaluate differences between groups. Medicaid discharges were compared to private payer discharges using Chi square analysis to identify differences in treatment, complications, and non-routine discharge.

RESULTS: 678,831 cases of proximal humerus fractures were identified. When comparing the Medicaid vs. private insurance groups, there are significant differences ($p<.001$ for all four fixation methods studied) in the proportion of patients undergoing open reduction and internal fixation (25.9% vs. 23.6%), total shoulder arthroplasty (0.6% vs. 0.8%), hemiarthroplasty (6.5% vs. 11.2%), and reverse shoulder arthroplasty (0.2% vs. 0.6%, respectively), but there were no differences in ($p=.730$) complications between these two payer groups. Chi square analysis also revealed significant differences ($p=.028$) in the rate of non-routine discharge between Medicaid and PI groups. Overall, there are significant differences ($p<.001$) between all payer groups in the CR, IHM, and NRD.

DISCUSSION AND CONCLUSION: Medicaid patients were found to have the highest THC and the longest LOS. Their treatment pattern was significantly different from the PI group, but their complication rate was not. This shows there are likely non-surgical related reasons for the increased costs incurred. Clearly there are treatment choices and cost discrepancies based on insurance type. As physician compensation moves towards an outcome based system, these results show that physicians should be appropriately compensated for more complex Medicaid patients.

MAOA SECOND PLENARY SESSION
April 15, 2016

The Effect of an Adjustable Hinged Operating Table on Lumbar Lordosis During Lumbar Surgery

Abstract ID: Paper 070

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INTRODUCTION: Hinged operative tables have the theoretical advantage of allowing surgeons to adjust lumbar spine positioning intraoperatively to facilitate both decompressive and fusion surgery. The amount of lumbar lordosis in neutral, flexion, and extension positions has not been quantified prospectively using a hinged table for prone lumbar spine surgery.

METHODS: Thirty patients scheduled to undergo elective lumbar decompression and/or discectomy at a single institution were consented for study enrollment between May 2013 and November 2014. Preoperative MRI as well as standing x-rays taken in neutral, maximal flexion, and maximal extension were obtained. Following prone positioning on an OSI Axis Jackson table, x-rays in neutral, maximal flexion, and maximal extension were taken using the table controls prior to the start of the procedure. Total lumbar lordosis was calculated in all 6 images utilizing the Cobb method by two physicians. The degeneration of the lumbar intervertebral discs was graded using Pfirrmann MRI disc grades. Intra-rater and inter-rater reliability was calculated, and comparisons of lumbar lordosis between radiographs were made.

RESULTS: The average age of the cohort was 42.5 years with 11 patients being female. Inter-rater and intra-rater reliability was strong with intraclass correlation coefficient ranges of 0.78-0.89 and 0.77-0.82, respectively. Lumbar lordosis on the operative table was 56.5˚ ± 2.1˚, 43.6˚ ± 2.2˚, 63.2˚ ± 2.0˚ in neutral, flexion, and extension, respectively. Lumbar lordosis on the standing films was 46.9˚ ± 3.1˚, 33.2˚ ± 2.8˚, 52.3˚ ± 3.3˚ in neutral, flexion, and extension, respectively. Average flexion (12.9˚ ± 1.1˚) and extension (6.7˚ ± 1.2˚) were significantly different from neutral on the operative table ($p < .001$). Lumbar lordosis was significantly higher on the operative table ($p < .001$) in comparison to standing films. Total range of motion (maximal extension to maximal flexion) was 19.6˚ ± 1.9˚ on the table and 19.1˚ ± 2.0˚ on standing films without significant difference ($p = 0.42$). Average Pfirrmann disc grade for the cohort was 2.77 ± 0.10. No significant correlation was found between disc score and total lumbar range of motion ($p = 0.40$).

DISCUSSION: In this cohort, the hinged operative table allowed for a physiologic arc of motion of nearly 20˚ from flexion to extension. Measurements of lumbar flexibility were unaffected by disc degeneration. A considerable amount of lumbar sagittal motion can be obtained on hinged operative tables without decreasing overall lumbar lordosis below physiologic levels.

Tranexamic Acid Reduced Blood Loss but Not Transfusion After Hip Arthroplasty for Femoral Neck Fracture: A Randomized Clinical Trial of 138 Patients

Abstract ID: Paper 071

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INTRODUCTION: Tranexamic acid (TXA) has been shown to limit blood loss and transfusion in elective hip arthroplasty, but there is limited data on its use in arthroplasty for femoral neck fracture (FNF). Our goal was to investigate the effects of intravenous (IV) TXA on patients undergoing hip arthroplasty for acute FNF. Specifically, we asked: (1) does TXA reduce calculated blood loss, (2) does TXA reduce the incidence of allogenic blood transfusion, and (3) are there any observable differences in 30- and 90-day complications with TXA administration?

METHODS: We performed a prospective, double-blinded, randomized controlled trial wherein patients undergoing either hemi- or total hip arthroplasty for acute FNF were administered TXA vs. placebo at the time of surgery. Of 281 patients eligible for review, 138 were randomized to receive either IV TXA or placebo (69 patients in each group). There were more patients with coronary stents in the TXA group, but demographics, medical characteristics, and surgical specifics were otherwise similar between groups. Follow-up was available for all patients through 90 days. Data included calculated blood loss, transfusion requirement, hospital readmission, and 30- and 90-day complications.

RESULTS: TXA was effective in decreasing mean calculated blood loss (305 ml less for patients in the TXA group [p=0.0005]). Fewer patients received transfusions in the TXA group (17%) when compared to the placebo group (26%), but this was not statistically significant (p=0.22). TXA was safe with no differences in adverse events at 30 and 90 days.

DISCUSSION AND CONCLUSION: This randomized clinical trial found TXA was safe and effective in reducing blood loss, but could not show a difference in transfusion for patients undergoing hip arthroplasty for femoral neck fracture. Whether 305 ml decrease in blood loss with TXA is clinically important or if a larger cohort would find a significant difference in transfusion is worthy of further study.

Articulating vs. Static Spacers in the Management of Periprosthetic Knee Infection: A Randomized Clinical Trial

Abstract ID: Paper 072

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BACKGROUND: Although the use of an interim antibiotic loaded spacer is considered standard for a two-stage exchange for periprosthetic joint infection (PJI), the use of articulating vs. a static spacer is controversial. The purpose of this multicenter, randomized control trial is to compare articulating and static spacers for the treatment of PJI after total knee arthroplasty (TKA).

METHODS: 52 Patients who met MSIS criteria for PJI following a primary TKA at 3 centers were randomized; 26 into the articulating and 26 in the static group. Antibiotics and reimplantation timing were managed using the standard of care of each surgeon and institution. Power analysis determined that 56 patients were needed to identify a 13° difference in range of motion (ROM) between groups (β=0.80 and α=0.05). Demographics between the two groups were not significantly different, suggesting appropriate randomization.

RESULTS: At a mean of 1.7 years (range, 1.0 to 2.9) following reimplantation, ROM was significantly better in patients who had an articulating spacer (113.1° vs. 99.9°, p=0.033). There was a trend toward a higher rate of re-infection among static spacers (13% vs. 5%); however, this difference was not significantly different with the numbers available for study (p=0.582). Similarly, the mean Knee Society Score was somewhat higher at 83 for the articulating and 74 for the static group (p=0.264). There was no difference in mean operative time at the first (129 vs. 134 minutes, p=0.711) or second stage (146 vs. 149 minutes, p=0.823). There was no difference in length of stay after the first stage (5.5 vs. 5.9 days, p=0.667) or second stage (3.9 vs. 4.1 days, p=0.596).

CONCLUSIONS: This randomized trial demonstrates that articulating spacers provide significantly better range of motion than static spacers in the treatment of PJI after TKA with a non-significant trend towards higher Knee Society Scores and decreased infection recurrence.

Proximity of Lateral Critical Structures to the All-Epiphyseal Outside-In Femoral Tunnels in Pediatric ACL Reconstruction

Abstract ID: Paper 073

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BACKGROUND: Anterior cruciate ligament (ACL) tears in the pediatric population is on the rise due to increasing participation and intensity of competitive sports at an early age. When neglected, ACL deficiency leads to meniscal tears, chondral damage, and poor outcomes. Therefore, early anatomic ACL reconstruction has been advocated. However, ACL reconstruction in the skeletally immature athlete is challenging due to the presence of physes and this has led to the development of all-epiphyseal reconstruction techniques. These techniques result in a horizontal femoral tunnel that exits distally in the lateral femoral condyle, which may place the lateral collateral ligament (LCL), popliteus tendon (PT), articular cartilage (AC), and peroneal nerve (PN) at risk. To our knowledge, this is the first study evaluating the proximity of the lateral structures to the femoral tunnel in all-epiphyseal outside-in ACL reconstructions.

METHODS: Twelve all-epiphyseal ACL reconstructions were performed on human cadaveric knees using arthroscopy and outside-in drilling for anatomic femoral tunnel placement. Following reconstruction, the lateral side of the knee was dissected and the LCL, PT, distal and posterior AC, and the PN were identified. The distances of these structures from the center of the exiting femoral tunnel were then measured using a digital caliper at 0°, 30°, 60°, 90°, and 120° of knee flexion. Any gross damage to these structures caused by femoral drilling was noted.

RESULTS: Clear violation of the LCL was noted in 3 specimens and of the PT in 1 specimen. As the knee was progressively flexed, the distance between the LCL and the femoral tunnel decreased significantly ($P<0.001$) with an average distance of 6.52 mm at 0°, 6.26 mm at 30°, 4.23 mm at 60°, 2.38 mm at 90°, and 0.4 mm at 120°. The distance between the PT and the femoral tunnel also decreased significantly ($P<0.001$) with knee flexion with average distances to center of 8.07 mm at 0°, 7.75 mm at 30°, 6.33 mm at 60°, 4.12 mm at 90°, and 1.89 mm at 120°. The PN and AC were respected in all specimens.

CONCLUSIONS: The LCL and PT are at risk during femoral drilling for all-epiphyseal anatomic ACL reconstruction using an outside-in technique. This risk was maximized at 120° flexion and minimized in full extension. These findings suggest that the optimal position for femoral drilling in all-epiphyseal ACL reconstruction is full or near-full extension of the knee. This is the opposite of the recommended knee flexion angles in adult ACL reconstructions using an anteromedial portal.

MAOA BREAKOUT SESSION #6
FOOT AND ANKLE
April 15, 2016

Outcomes and Complications of Total Ankle Replacement in Patients With Post-Traumatic, Primary, and Inflammatory Ankle Arthritis: A Comparative Study

Abstract ID: Paper 074

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BACKGROUND: Previous literatures reported higher complications in patients who underwent total ankle replacement resulted from post-traumatic and inflammatory arthritis compared to primary arthritis. However, there is a lack of comparative studies to demonstrate outcomes and complications among three groups of patients.

MATERIAL AND METHODS: Retrospective chart review with prospectively collected data of 247 consecutive patients with 268 ankles who were diagnosed with end-stage ankle arthritis from primary (73 patients/86 ankle), post-traumatic (149 patients/154 ankle), and inflammatory arthritis (25 patients/28 ankle) and underwent total ankle replacement between 1997 and 2015. Mean follow-up was 70.6 months (6-132 months), 63.4 months (6 to 180 months), and 79.1 months (12-162 months) for primary, post-traumatic, and inflammatory arthritis. The primary outcome was VAS, FFI, SF-36, and secondary outcomes included 5- and 10-year survival rate, length of hospital stay, time to return to work, sports, activity daily living, ankle range of motion at final follow-up, and complications.

RESULTS: The most common cause was post-traumatic (57.5%) followed by primary (32.1%) and inflammatory arthritis (10.4%). There were significantly younger patients in inflammatory group, but there were significant longer follow-up time compared to post-traumatic and primary arthritis groups. All three groups demonstrated significant improvement in VAS, FFI, and SF-36. However, FFI, SF-36, VAS, ankle dorsiflexion and plantarflexion were similar among the three groups. Range of motion of ankle joint was significantly improved in both dorsiflexion and plantarflexion in all groups (p-value < 0.001). 5-year and 10-year survival rate were lower in primary arthritis group, but it did not reach statistical significance. Tibial subsidence was significantly higher in inflammatory group compared to post-traumatic group (p-value $= 0.036$), but other complications were similar among three groups.

CONCLUSION: Total ankle replacements demonstrated significant improvement in term of functional outcomes, clinical outcomes, and pain relief as measured with FFI, SF-36, VAS scores, and range of motion of ankle joint for treatment of end-stage ankle arthritis. The functional outcomes and complications were comparable among three groups except talar implant subsidence was significantly higher in the inflammatory group. Further prospective clinical study is indicated.

Radiographic Assessment of Lower Extremity Alignment in Ankle Arthritis Using Long-Leg Alignment Views

Abstract ID: Paper 075

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BACKGROUND: Post-traumatic ankle arthritis is commonly associated with proximal lower extremity deformities. Malalignment proximally can impact decision-making and prognosis for ankle arthritis treatment such as total ankle replacement or arthrodesis. The purpose of this study is to determine the prevalence, specific location, and characteristics of lower extremity deformity in patients who present with ankle arthritis, and determine if there is a correlation between lower extremity radiographic parameters and degree of ankle arthritis.

METHODS: Fifty-three patients (59 ankles) with ankle arthritis were included. Mean age was 59 years (range 28 to 85). Inclusion criteria were radiographic findings of ankle arthritis and presence of LLA view. On LLA view, mean axis of deviation (MAD) at the knee, joint line congruence angle (JLCA) at the knee, anatomic medial proximal tibial angle (aMPTA), and anatomic lateral distal tibial angle (aLDTA) were measured on both extremities. Kellgren-Lawrence arthritis grade at the knee was obtained. Takakura, van Dijk, and COFAS ankle arthritis grades were obtained.

RESULTS: There were 15 female patients and 38 male patients (24 left, 35 right ankles). Prevalence of deformity was defined as a measurement at least one standard deviation outside of normal historical controls. For our population, 61.0% of extremities had MAD measurements outside this definition (9.7 +/- 6.8 mm); 20.3% had abnormal JLCA measurements (outside 0-2°); 27.1% had aMPTA measurements outside one standard deviation (87.2 +/- 1.5°), as did 47.5% of patients concerning aLDTA measurements (88.6 +/- 3.8°). Higher aLDTA was a significant predictor for allocation to a grade 3 Van Dijk ankle arthritis grade ($p<0.1$). Using multinomial logistic regression, Kellgren-Lawrence knee arthritis grade was significantly predictive of van Dijk ankle arthritis grade 2 and 3 compared to grade 1 ($p<.001$). When compared to historical controls, patients with van Dijk grade 3 had a statistically significant difference in MAD ($p<0.05$), while those with Takakura grade 4 were significantly different in MAD, knee JLCA, and MPTA measurements.

CONCLUSION: In patients with ankle arthritis, there is a high prevalence of lower extremity malalignment found when using the LLA view. While proximal malalignment was not found to be predictive of degree of ankle arthritis, it is important to recognize the presence of these deformities when surgical planning is performed. We recommend obtaining LLA view in all patients with ankle arthritis, in particular those who will undergo a total ankle arthroplasty.

Higher HbA1c Levels Indicate Higher Risk of Postoperative Infection Following Surgical Treatment of Ankle Fractures

Abstract ID: Paper 077

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INTRODUCTION: Ankle fractures are one of the most common fractures that often require surgical treatment by orthopedic surgeons. While postoperative infections are relatively low overall, diabetics who require surgical management of ankle fractures are at significantly higher risk. As of 2012, 29.1 million (9.3%) of Americans were affected by diabetes with an incidence of 1.7 million in recent years. Given the high and growing prevalence of diabetes, appropriate management of ankle fractures in this population is essential. We hypothesize that as HbA1c increases, the rate of postoperative infections will increase as well.

METHODS: A software platform was utilized to investigate a multicenter database of pooled electronic medical records of over 50 million patients from 26 U.S. healthcare networks. A cohort of healthy patients that had undergone surgical treatment of an ankle fracture was created, and the incidence of 30-day postoperative infections was calculated. This group was compared to cohorts of diabetic patients with hemoglobin A1c <7%, 7-9.9%, and >10%.

RESULTS: There were 62,160 patients in the open reduction internal fixation ankle fracture patient cohort and 14,070 of these patients had HbA1c measurements. Overall, patients with diabetes had an increased risk of developing postoperative infection (1.66% vs. 1.00%; relative risk 1.74, $p<0.0001$). Within this cohort, their risk correlated to their HbA1c levels. Patients with HbA1c under 7.0% were found to have a postoperative infection risk of 1.45% (relative risk 1.44, $p=0.0002$). When HbA1c was 7%-9.9%, patients' risk increased to 1.89% (relative risk 2.06, $p<0.0001$). As a patient's diabetes became uncontrolled with HbA1c levels surpassing 10%, postoperative infection rates rose to 2.84% (relative risk 3.05, $p<0.0001$).

CONCLUSION: As hemoglobin A1c levels increase, rates of postoperative infection increase in a stepwise fashion following surgical treatment of ankle fractures.

Incidence, Risk Factors, and Causes for 30-Day Unplanned Readmissions Following Primary Lower Extremity Amputation in Patients With Diabetes

Abstract ID: Paper 078

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BACKGROUND: The Centers for Medicare and Medicaid Services targeted 30-day readmissions as a quality of care measure. Hospitals can be penalized on unplanned readmissions. Studies have examined risk factors for unplanned readmission following orthopedic procedures. However, risk factors for readmission following lower-extremity amputation in diabetic patients have not been reported. Given the frequency of amputation in diabetics and our changing healthcare system, the purpose of this study was to determine the incidence, risk factors, and causes for unplanned 30-day readmission following primary lower-extremity amputation in diabetic patients.

METHODS: Patients with a diagnosis of diabetes undergoing primary lower extremity amputation between 2002-2013 were retrospectively identified in a single-center patient database. Chart review determined patient factors including co-morbidities, hemoglobin A1c, amputation level, and demographics. Patients were divided into groups with and without unplanned readmission within 30 days postoperatively. Univariate and multivariate logistic regression analyses were used to compare cohorts and to identify variables associated with readmission.

RESULTS: Overall, 46 of 439 diabetic patients undergoing primary lower-extremity amputation had an unplanned 30-day readmission (10.5%). The top reason for readmission was medical (43.5%), followed by major surgical events requiring return to OR (37.0%) and minor surgical events (13.0%). In the univariate analysis, discharge on antibiotics (p=0.002), smoking (p=0.003), chronic kidney disease (p=0.002), peripheral vascular disease (p=0.002), and higher Charlson Comorbidity Index (p=0.001) were each associated with readmission. In the multivariate analysis, diagnosis of gangrene (odds ratio, 2.95; 95% confidence interval, 1.37-6.35), discharge on antibiotics (OR, 4.48; 95% CI, 1.71-11.74), smoking (OR, 3.22; 95% CI, 1.40-7.36), chronic kidney disease (OR, 2.82; 95% CI, 1.30-6.15), and peripheral vascular disease (OR, 2.47; 95% CI, 1.08-5.67) were independently associated with readmission.

CONCLUSION: Thirty-day readmission rates following primary lower-extremity amputation in patients with diabetes are high at over 10%. Both medical and surgical complications contributed to readmission, many unavoidable. Quality reporting metrics should include these risk factors to avoid undeservedly penalizing surgeons and hospitals caring for this patient population.

The Effect of Obesity on Forefoot Surgery

Abstract ID: Paper 079

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INTRODUCTION: The prevalence of obesity is increasing throughout the United States and presents many challenges to orthopedic surgeons. Obesity has been shown to increase perioperative complications rates in total joint, trauma, and spine surgery, but no study to date has examined its effect specifically in forefoot surgery. Much of forefoot surgery is elective, so it is important to define risk factors in order to educate patients on potential complications. The purpose of this study was to determine if obesity is an independent risk factor for increased complications after forefoot surgery.

METHODS: A retrospective review of records identified 633 patients who had forefoot surgery by one of three foot and ankle fellowship-trained orthopedic surgeons at one institution between 2008 and 2010. All patients who currently smoked or smoked in the past were excluded to eliminate a confounding factor, as smoking is known to increase complication rates. This left 427 patients for inclusion, 299 non-obese (BMI <30) and 128 obese (BMI> 30). Medical records were reviewed for the occurrence of complications, including nonunion, delayed union, delayed wound healing, infection, and persistent pain.

RESULTS: The overall complication rate was 9% with similar rates between obese and non-obese patients (10% vs. 9%). The only specific complication approaching significance ($p=0.13$) was a higher rate of infection in obese patients (4% vs. 1%), but this higher rate was secondary to the higher percentage of diabetic patients in the obese group. Multivariance analysis showed that diabetic patients, regardless of weight, had significantly higher rates of infection ($p=0.03$), with a trend towards higher rates of overall complications and delayed wound healing ($p=0.08$ and $p<0.06$ respectively).

CONCLUSIONS: Obesity was not shown to lead to more frequent complications after forefoot surgery. Diabetes was associated with significantly higher rates of infection after forefoot surgery, regardless of weight. Though not significant, there was a trend towards higher rates of overall complications and delayed wound healing in diabetic patients as well.

LEVEL OF EVIDENCE: Level III, retrospective, comparative study
KEY WORDS: Forefoot surgery, obesity, complications, diabetes

Suture Button Fixation vs. Syndesmotic Screws in Supination-External Rotation Type 4 Injuries: A Cost Effectiveness Analysis

Abstract ID: Paper 080

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BACKGROUND: In stress positive unstable supination-external rotation type 4 (SER IV) ankle fractures, implant selection for syndesmotic fixation has proven a debated topic. Among the available syndesmotic fixation methods, the “gold standard” metallic screw and suture button fixation have been compared in the literature. In addition to strength of fixation and ability to anatomically restore the syndesmosis, costs associated with implant use have recently been called into question.

PURPOSE: To examine the cost effectiveness of Tightrope fixation, and determine whether the Tightrope is more cost effective than two 3.5 mm syndesmotic screws not removed on a routine postoperative basis.

STUDY DESIGN: Economic and decision analysis; Level of evidence, 2.

METHODS: The highest level of available literature was used to estimate the hardware removal and failure rates for syndesmotic screws and suture button fixation. Costs were determined by examining the average costs for patients who underwent surgery for unstable SER IV ankle fractures at a single level one trauma institution. A decision analysis model was developed which allowed comparison of the two fixation methods.

RESULTS: Using a 20% screw hardware removal rate and 4% Tightrope removal rate, the total discounted cost for syndesmotic screws was $20,836, and the total discounted effectiveness was 5.846 QALYs over an 8-year-time period. The total discounted cost for Tightrope fixation was $19,354 and the total discounted effectiveness was 5.904 QALYs over the same time period. Sensitivity analysis was conducted regarding both the cost of Tightrope fixation ($880) as well as rate of screw hardware removal (20%). In order to become more cost effective, the screw hardware removal rate would have to be reduced to at least 5%. Further, at an increased cost of $2000, Tightrope fixation remained the more cost-effective treatment strategy.

CONCLUSION: This cost-effectiveness analysis suggests that for unstable SER IV ankle fractures, Tightrope fixation is more cost effective than syndesmotic screws not removed on a routine basis. Tightrope fixation was a dominant treatment strategy, as patients on average spent $1482 less and had a higher quality of life by 0.058 QALYs when compared to syndesmotic screws. Assuming functional outcomes and failure rates to be equivalent, screw fixation only became more cost effective when the screw hardware removal rate was reduced to 5%, or the cost of Tightrope fixation exceeded $2000.

Neutralization vs. Anti-Glide Plating for the Treatment of Isolated Weber B Fibula Fractures

Abstract ID: Paper 081

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INTRODUCTION: Operatively treated fibula fractures are typically stabilized with a neutralization plating (NP) technique. Anti-glide plating (AP) provides an alternative fixation strategy with similar biomechanical stability. Few studies directly compare outcomes of distal fibula fractures using NP or AP. We hypothesize that AP provides similar functional outcomes compared to NP at a lower overall cost.

METHODS: Following IRB approval, all patients with isolated Weber B fibula fractures who presented to our Level 1 trauma center and were treated surgically from 2007-2014 were identified. Patients with syndesmotic injuries or concomitant medial or posterior malleolus fractures were excluded. Overall cost was determined by the combined sum of operating room charges, including use of operating theatre and anesthesia time, and implants used in the procedure. Functional outcomes were assessed via mailed questionnaires using the Medical Outcomes 36-Item Short-Form Health Survey (SF-36) and Foot and Ankle Disability Index (FADI).

RESULTS: Sixty patients were included in the study. Thirty-one patients were treated with NP whereas 29 were treated with AP. Median age of the cohort was 45 years (range, 21-86) with an average BMI of 29.6 (range, 20-53). There were no statistically significant differences between treatment groups in regards to age, BMI, tobacco use, diabetes status, or fracture laterality. Mean OR time (77 vs. 65 min, $p=0.04$) and OR cost ($13,472 vs. $11,860, $p=0.04$) for the NP group was significantly higher than the AP group. In addition, mean plate size (5.3 vs. 7.4 holes, $p<0.001$), number of cortical screws (3.4 vs. 4.5, $p<0.001$), and number of cancellous screws (<1 vs. 2, $p<0.001$) utilized were significantly less for AP group, resulting in a significantly lower overall implant cost ($207 vs. $314.11, $p<0.001$) for the AP group. Twelve (39%) patients in the NP and nine (31%) in the AP group completed SF-36 and FADI at similar average follow-up times (23 months vs. 36 months, $p>0.05$). The NP group reported scores of 49.9 (24.9-64.6), 45.5 (9.6-62.8), and 88.1 (39.4-100) for the SF-36 physical component score, SF-36 mental component score, and FADI, respectively. The AP group reported scores of 47.2 (34.3-56.6), 43.1 (24.9-64.6), and 82.0 (29.8-100). No statistically significant differences in functional scores were found between groups ($p>0.05$).

DISCUSSION: Anti-glide plating for isolated Weber B fibula fractures provides equivalent patient-reported functional outcomes compared to neutralization plating at a significantly lower overall cost.

Predictors of Long-Term Functional Outcome in Operative Ankle Fractures

Abstract ID: Paper 082

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INTRODUCTION: While risk factors associated with short-term functional outcome in operative ankle fractures have been reported, no previous studies have reported on the association between these risk factors and long-term functional outcome. We seek to clarify this relationship using Patient Reported Outcomes Measurement System (PROMIS) physical function and pain interference measures.

METHODS: We retrospectively reviewed a multicenter cohort of 154 patients with operatively treated closed ankle fractures from 2001-2013 with a minimum of two-year follow-up. Exclusion criteria included chronic ankle fractures, Maisonneuve fractures, posterior pilon variants, and patients with previous ankle surgery. Patients were evaluated with the PROMIS physical function (PF) and pain interference (PI) computerized adaptive tests. Patient risk factors including sex, age, diabetes, smoking, ASA class, BMI, education level, ankle dislocation, energy of injury, syndesmotic injury, and AO/OTA fracture type were obtained through chart review. Preliminarily, mean PF and PI scores were analyzed using two-tailed student's t-tests for binary variables and Pearson's correlation for non-binary variables. Hierarchical multivariate linear regression was used to identify independent predictors of physical function and pain interference at long-term follow-up.

RESULTS: At average 6.2 year follow-up (range 2–14), patients had a mean PF score of 52.5 (standard deviation [SD] 10.3) and a mean PI score of 47.3 (SD 8.5). There was no association between PF or PI scores and smoking, education level, ankle dislocation, energy of injury, AO/OTA classification, presence of a syndesmosis injury, presence of a medial malleolus fracture, or presence of a posterior malleolus fracture. Independent predictors of decreased PF score included higher ASA class (β=0.662, p=0.001) and higher BMI (β=0.268, p=0.004). Independent predictors of decreased PI score included diabetes (β=0.255, p=0.021) and higher BMI (β=0.249, p=0.017).

CONCLUSION: Preoperative factors associated with decreased physical function in the long-term following operative ankle fractures include higher ASA class and BMI. Factors associated with increased pain include diabetes and higher BMI.

Preoperative Narcotic and Alcohol Use Are Risk Factors for Complication in Ankle and Hindfoot Reconstruction

Abstract ID: Paper 083

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INTRODUCTION: Predictors of complications after foot and ankle surgery have been well documented; however, some potentially confounding medical and psychological diagnoses have not been assessed regarding their relationship to outcomes. The purpose of this study was to examine medical, social, and psychological factors associated with complications and reoperations after elective ankle and hindfoot reconstruction.

METHODS: 139 cases of total ankle replacement, ankle fusion, and/or hindfoot fusion were identified with a minimum 2-year follow-up. Retrospective chart review determined patient demographics, medical comorbidities, and associated surgical procedures. Specific preoperative factors examined were age, sex, body mass index, etiology, diabetes, tobacco use, alcohol use greater than two or more drinks per day, chronic pain disorder, mood disorder, and any preoperative narcotic use 3 months prior to surgery. Primary outcomes included complications and reoperations. A major complication was defined as infection, nonunion, or failure requiring revision or reoperation; otherwise, the complication was considered minor. Bivariate and multivariate logistic regression were used, in addition to student's T-test and Fisher's exact test, for continuous and categorical data, respectively. P-values less than 0.05 were considered significant.

RESULTS: The overall complication rate was 28%. Minor complication rate was 23% and major complications occurred in 6.5%. Including elective implant removal, reoperation rate was 17%. Alcohol use (53%; OR=3.87, 95% CI [1.17-12.84], p=0.03) and preoperative narcotic use (40%; OR=2.63, 95% CI [1.21-5.75], p=0.02) were risk factors for complications in a multivariate model. Superficial wound infection was significantly more frequent in alcohol users (31%, p=0.03), and deep infection (6%, p=0.045) and nonunion (24%, p=0.046) were significantly more frequent with pre-surgery narcotic use. Older patients were less likely to undergo reoperation (OR=0.97, 95% CI [0.94-0.995], p=0.02). Age, sex, body mass index, etiology, diabetes, mood disorder, and chronic pain disorder were not associated with increased complications.

DISCUSSION AND CONCLUSION: Patients who consumed two or more drinks of alcohol per day or had been prescribed any amount of narcotic within 3 months prior to surgery were at increased risk for complications, specifically infection and nonunion. Surgeons should be aware of these factors and counsel patients before surgery.

The Arterial Anatomy of the Deltoid Ligament: A Cadaveric Study

Abstract ID: Paper 084

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INTRODUCTION: Injuries to the deltoid ligament complex on the medial aspect of the ankle account for 10-15% of ankle sprains. Chronic deltoid insufficiency can lead to medial or multidirectional ankle instability, necessitating operative stabilization. Many studies have examined the anatomy of the deltoid ligament complex, with a focus on characterizing the various bands that comprise its structure. To our knowledge, the vascular supply to the deltoid ligament has not been previously studied. This information may have implications in the progression of deltoid injuries to chronic insufficiency, and is an important consideration when performing operative reconstruction of the deltoid ligament. The purpose of our study was to describe the vascular supply to the deltoid ligament utilizing a method of chemical debridement with cadaveric specimens.

METHODS: Nineteen matched pairs of adult cadaver legs, 38 legs total, were studied. Specimens with any signs of prior trauma or surgical treatment were excluded. The legs were amputated below the knee and injected with India Ink, followed by Ward Blue Latex, in the anterior tibial, posterior tibial, and peroneal arteries. Specimens were chemically debrided utilizing 6.0% sodium hypochlorite, leaving vascular casts, ligaments, and bones. The vascular supply to the deltoid ligament was evaluated, photographed, and recorded.

RESULTS: The vascular supply to the deltoid ligament complex was clearly visualized in 35 of the specimens. The deltoid ligament in all specimens was supplied by arterial branches from the dorsalis pedis (specifically the medial tarsal arteries) and anterior tibial arteries (60.0%, n=21) and the dorsalis pedis artery only (40.0%, n=14). Twenty-seven specimens (77.1%) had additional arterial supply to the deltoid ligament from the posterior tibial artery. In six of these specimens, the posterior tibial artery provided the dominant arterial supply.

CONCLUSIONS: Ankle sprains are common injuries, with up to 15% involving the deltoid ligament complex. Deltoid injuries can become chronic in nature, leading to recurrent ankle instability. Our study shows that the deltoid ligament complex receives a consistent arterial supply from the dorsalis pedis and anterior tibial arteries, and that this anterior vasculature is the dominant supply in the majority of specimens. A large portion of our specimens also had additional arterial supply from the posterior tibial artery. Knowledge of the arterial anatomy of the deltoid ligament complex is valuable when planning operative treatment of medial ankle, and may also provide information for future studies examining the progression of medial ankle sprains to chronic deltoid insufficiency.

The Evaluation of Traditional Fixation vs. Suture-Mini Plate Reduction of the Ankle Syndesmosis

Abstract ID: Paper 085

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INTRODUCTION: Disruption of the distal tibiofibular syndesmosis can accompany severe external rotation ankle injuries. At the author's institution, the senior author has transitioned to a non-proprietary transosseous suture technique in conjunction with mini-fragment plates. This technique is inexpensive, expeditious, and achieves the goals of maintaining flexible syndesmotic reduction. In locations where proprietary systems are unavailable and repeat surgery represents an undue burden, it represents a simple, reproducible technique. This study aims to compare the clinical outcomes of patients treated with suture-mini plate fixation with traditional methods of syndesmotic fixation.

METHODS: This study is a retrospective review of all syndesmotic repairs by a single fellowship-trained, foot and ankle surgeon performed from August 2004 to February 2014. A total of 72 consecutive patients who underwent open reduction of the ankle syndesmosis were evaluated: 35 patients with screw fixation, 27 with tight rope fixation, and 10 with the suture-mini-plate fixation. Patients with less than 3 months follow-up, and ipsilateral orthopedic procedures affecting weight-bearing status were excluded from the study. Outcomes measured were complication rates (painful hardware, infection, heterotopic ossification, granuloma, fracture, additional procedure), Short Form-12 Health Survey Physical and Mental Composite Score (SF-12 PCS, SF-12 MCS), and Foot and Ankle Disability Index (FADI) scores. Average follow-up was 24-98 months (average 30 months).

RESULTS: Average FADI scores were highest in the Suture-Mini-Plate group (90.50 ± 9.61, n=8) vs. Tightrope group (87.77 ± 17.06, n=14) vs. Screw group (69.45 ± 28.65, n=13). Average SF-12 PCS scores were highest in mini plate group (51.26 ± 6.68, n=7) vs. tightrope (43.45 ± 11.78, n=13) vs. screws (43.45 ± 11.78, n=13). Average SF-12 MCS scores were highest in Mini plate group (57.09 ± 4.21, n=7) vs. tightrope (52.50 ± 8.22, n=13) vs. screws (51.03 ± 11.93, n=13). Complication rates were least in the mini plate group (90%) vs. screw (85.29%) vs. tightrope (61.54%). There was a statistically significant difference in FADI scores (p=0.044) and complication rates (p=0.05) between the mini plate group and traditional fixations types. No other effects reached significance (SF-12 PCS, p=0,099; SF-12 MCS, p=0.390).

CONCLUSIONS: This retrospective review identified the effectiveness of suture-mini plate fixation when evaluating for postoperative complication rates, need for additional procedures, and patient self-reported outcomes. This novel, non-proprietary technique proved to be superior to traditional methods of syndesmotic fixation. Mini plate suture fixation should be considered as an effective and cost beneficial choice of fixation when treating syndesmotic injuries.

Functional Impairment of Patients Undergoing Surgical Correction for Charcot Foot Arthropathy

Abstract ID: Paper 086

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INTRODUCTION: Previously, reduced self-reported quality of life has been demonstrated in Charcot foot arthropathy patients using the Medical Outcomes Study Short Form 36 Healthy Survey (SF-36) and the American Orthopaedic Foot and Ankle Society Diabetic Foot Questionnaire (AOFAS-DFQ). The Short Musculoskelatal Function Assessment has been widely used in the management of patients with a broad range of musculoskeletal disorders and has been shown to be a valid instrument for clinical assessment.

Understanding the impact of Charcot foot arthropathy on quality of life is essential in helping better establish the optimal methods of management and timing intervention. Historically, the traditional non-surgical accommodative treatment for diabetes-associated Charcot foot arthropathy has been unsuccessful in improving the quality of life in affected individuals. This has led to the growing interest in surgical correction of the acquired deformity.

METHODS: The SMFA consists of two indices (function index and bother index) and four subscales (daily activities, emotional status, arm and hand function, and mobility). Twenty-five patients completed the Short Musculosketal Functional Assessment (SMFA) prior to undergoing surgical correction of their deformity associated with diabetes-related Charcot foot arthropathy. There were 16 males and 9 females. The average BMI was 37.35 (range 25.83-50.22), and the average Hemoglobin A1C was 7.54 (range 5.3-10.1) prior to surgery. The deformity was between the talonavicular and tarsal-metatarsal joints in all patients.

RESULTS: All 25 patients exhibited significant impairment in all six domains of the SMFA ($p<0.0001$) as compared to the literature normative data on a 100-point scale. There was a high correlation between each of the six domains of the SMFA, even after correcting for BMI.

CONCLUSION: Charcot foot arthropathy imparts a severe negative impact on health-related quality of life above and beyond the impact of morbid obesity. This impairment equally impacts all of the functional and emotional domains measured with the SMFA as compared with population norms. This investigation will serve as a thorough benchmark for measuring the positive or negative impact of surgical correction.

MAOA BREAKOUT SESSION #7
SPORTS/SHOULDER
April 15, 2016

Latarjet Fixation: A Biomechanical Cadaveric Study Comparing Methods of Fixation

Abstract ID: Paper 087

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INTRODUCTION: The Latarjet coracoid transfer and its modern iterations have been effective in restoring stability in patients with anterior shoulder instability with greater than 25% glenoid bone loss. Complication rates of up to 25% have been previously reported with this procedure. More failures were noted in those that had fixation of the coracoid graft with cannulated screws than solid screws. The purpose of the present study was to assess the strength of cortical screws in comparison to cannulated cancellous screws.

METHODS: Ten fresh-frozen matched pair shoulder specimens from three males and two females (average age 56.6 years, range 32-67) were randomized into two separate fixation groups: (1) 3.5 mm stainless steel cortical screws or (2) 4.0 mm stainless steel partially threaded cannulated cancellous screws. All shoulder specimens had bone densitometry performed prior to preparation (average 0.516, range 0.396-0.657). Shoulder specimens were dissected free of all soft tissues and a 25% glenoid defect was created. The coracoid was osteotomized proximal to its angle and fixed flush with its long axis parallel to the glenoid defect with 2 parallel screws in compression fashion. The scapula was potted into a rectangular container using polymethylmethacrylate and a plastic hemi-disk was used to directly load the graft in order to standardize the loading of the graft across all specimens. A cyclic loading protocol was used with a crosshead speed of 0.25 mm per second and load amplitude of 300N. The minimum and maximum loads were increased by 25N every 20 cycles. Failure was described as: (1) fracture of coracoid graft, (2) screw cutout, or (3) screw breakage.

RESULTS: All ten specimens failed by screw cutout. Nine out of ten specimens failed by progressive displacement with an increased number of cycles. One specimen in the 4.0 mm screw group failed by catastrophic failure upon initiation of the testing protocol. In cycles to failure, the 3.5 mm screws and 4.0 mm screws failed at mean 274.2 (SD 170.9, range 10-443) and 135 (SD 140.8, range 0-284) cycles, respectively (p=0.144). The 3.5 mm screws required an average of 7.19 joules to failure (SD 2.73, range 3.30-10.67), while the 4.0 mm screws required an average of 5.82 joules to failure (SD 3.29, range 1.94-9.21) (p=0.676).

CONCLUSION: There was no statistically significant difference in cycles or energy to failure when comparing cortical screws vs. cannulated cancellous screws.

Hospital Admission is an Independent Risk Factor for Infection Following ACL Reconstruction

Abstract ID: Paper 088

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INTRODUCTION: Infection following anterior cruciate ligament (ACL) reconstruction, though rare, is associated with significant morbidity. Previous authors have found diabetes and smoking to be independent risk factors for infection in the setting of ACL reconstruction. We assessed a large, multi-center cohort in an effort to understand patient and surgical factors associated with infection after ACL reconstruction.

METHODS: We identified patients undergoing elective ACL reconstruction in the National Surgical Quality Improvement Program (NSQIP) database between 2007 and 2013. Surgical site infection (superficial or deep) within 30 days of the index procedure was the primary outcome. Case complexity was compared by assessing the mean number of associated CPT codes accrued during ACL reconstruction. We performed univariate and then multivariate analyses to identify risk factors for infection.

RESULTS: Postoperative infection was diagnosed in 39 of the 6398 (0.61%) ACL reconstructions available for analysis. Univariate analysis identified dyspnea, low preoperative hematocrit, operative time greater than 1 hour, and hospital admission following surgery as predictors of postoperative infection. Hospital admission occurred in 15.4% of patients who did develop an infection vs. 5% of patients who did not develop infection ($p=0.005$). Diabetes was present in 5.13% of patients who developed an infection compared to 1.71% of those who did not; however, this difference was not significant ($p=0.14$). Age, smoking status, case complexity, and body mass index (BMI) were not different between those who developed an infection and those who did not ($p>0.05$). Multivariate analysis identified hospital admission following surgery (odds ratio, 3.11; 95% confidence interval, 1.26-7.65) as an independent predictor of postoperative infection.

DISCUSSION: Hospital admission following ACL reconstruction may predispose patients to infection. Diabetes and smoking were not found to predict infection in our cohort. This is the first study that has identified postoperative hospital admission as an independent predictor of postoperative infection for patients undergoing ACL reconstructions. Surgeons should optimize outpatient operating systems and practices to aid in same-day discharges following ACL reconstruction.

Biomechanical Comparison of Single Bundle vs. Double Bundle Posterior Cruciate Ligament Reconstruction Techniques

Abstract ID: Paper 089

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PURPOSE: Controversy exists regarding double bundle vs. single bundle PCL reconstruction. Conflicting results have been reported in biomechanical and clinical studies with graft type, technique, and patient variables affecting the results. In this study, we compared the immediate post-implantation biomechanics of single bundle and double bundle reconstructions that encompassed these variables.

METHODS: Twenty (n=20) knees of various sizes were distributed and randomly assigned to one of five techniques (n=4 knees/technique), performed by three different surgeons experienced in the individual technique(s). The three single bundle reconstruction techniques (n=12) were: all-inside arthroscopic inlay, all-inside suspensory fixation, and arthroscopic-assisted open onlay. The two double bundle reconstruction techniques (n=8) were: arthroscopic-assisted open inlay and all-inside suspensory fixation. Each knee was potted and connected to a servo-hydraulic load frame (Instron 8821s) for biomechanical testing in three conditions: Native knee (PCL-intact), after PCL debridement (PCL-deficient), and after PCL reconstruction. Testing consisted of a posterior-directed force up to 100 N (mimicking immediate postoperative loading) at 1 N/s at four knee flexion angles: 10°, 30°, 60° and 90°. The properties measured were: load to 5 mm posterior displacement, maximal displacement (at 100N load) and stiffness. Data for each knee were normalized to the PCL-intact knee, combined to form 2 groups (single and double bundle reconstructions), then compared to each other and to the mean for all PCL-intact knees and all PCL-deficient knees using one-way analysis of variance (ANOVA).

RESULTS: Intact knees were significantly stiffer than single bundle PCL reconstructions (SB) at all knee flexion angles ($p<0.02$) and significantly stiffer than double bundle PCL reconstructions (DB) at all angles except 10° ($p<0.05$). DB were significantly stiffer than SB at all angles except 30° ($p<0.05$). Intact knees had significantly less laxity than SB ($p<0.03$) and DB ($p<0.05$) at 60° and 90°. DB had significantly less laxity than SB at all angles except 60° ($p<0.05$). Intact knees required significantly more load than SB at 30°, 60°, and 90° ($p<0.01$) and higher than DB at 60° and 90° ($p<0.05$). DB required significantly more load than SB at 30°, 60°, and 90° ($p<0.01$).

CONCLUSION: Neither single bundle nor double bundle PCL reconstruction techniques were able to completely replicate the biomechanical properties of the native PCL immediately after implantation. However, double bundle reconstructions were biomechanically superior to single bundle reconstructions regardless of graft type, technique, and patient variables and may be preferred for clinical use when immediate post-reconstruction graft strength and stability are critical.

Factors Affecting Return to Baseline Function at Six Months Following Anterior Shoulder Instability Surgery: A Multi-Center Orthopedic Outcomes Network (MOON) Shoulder Group Cohort Study

Abstract ID: Paper 090

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BACKGROUND AND PURPOSE: Preoperative and surgical factors related to early return to baseline function after anterior shoulder instability surgery are not clear. This study was designed to determine the preoperative and operative factors affecting return to baseline function at 6 months following anterior shoulder instability surgery. Identifying these factors will help surgeons establish expectations for functional return postoperatively.

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

METHODS: The Multicenter Orthopaedic Outcomes Network (MOON) shoulder group enrolled patients undergoing surgery for shoulder instability from 16 sites throughout the United States. Initial demographic data and validated, patient-oriented outcomes questionnaires were collected along with the physicians documented initial physical examination, treatment, surgical findings, and surgical techniques used at the time of surgery. At the six-month follow-up visit, range of motion (ROM) and strength measurement of the operative shoulder were collected and compared to preoperative measurement. Return to baseline was defined as return to within -10° ROM and full strength at the six month physical examination.

STATISTICS: Continuous and categorical data were analyzed using student t-tests and chi-square tests, respectively. The Kruskal-Wallis/Wilcoxin tests were used to compare groups that were not normally distributed. Factors reaching significance in a univariate analysis were then applied in a multivariable model. Significance was set a $p<0.05$.

RESULTS: A total of 281 patients with anterior instability of the shoulder were identified. 208 patients had complete pre- and post-surgical range of motion and strength measurements. 102 (49%) patients returned to baseline and 106 (51%) patients did not return to baseline. Univariate analysis identified age (p=0.027), Beighton score (p=0.0004), SF-36 general health (p=0.007), WOSI (p=0.015), duration of symptoms (p=0.013), and number of dislocations (p=0.045) as significant factors. When these factors were placed into a multivariate model, significant differences were identified in age (p=0.011), SF-36 General health (p=0.048), and Beighton score (p=0.006).

CONCLUSIONS: Older age, perception of general health, and generalized joint laxity are associated with failure to return to baseline function at six months after anterior shoulder instability surgery. Duration of symptoms and number of dislocation events did not reach significance in the multivariate model, but trended toward likelihood of failure to return to baseline findings. Moreover, open vs. arthroscopic surgery and number of suture anchors were not significant, suggesting that preoperative condition and not surgical factors predict return to baseline in the short-term.

ACL Tears in School-Aged Children and Adolescents: Has There Been an Increased Incidence Over the Last 20 Years?

Abstract ID: Paper 092

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PURPOSE: Anterior cruciate ligament (ACL) tears are thought to be occurring with greater frequency in young patients. To our knowledge, no study has specifically shown there to be an increased incidence of ACL tears in children over time. The purpose of this study is to determine if the incidence of ACL tears has increased in this age group over the past 20 years.

METHODS: A retrospective review of an insurance company's billing data was performed for children and adolescents aged 6-18 years with ICD-9 codes for ACL tear and CPT code for ACL reconstruction from January 1994 - December 2013. Analysis included year-by-year total incidence, with break down by sex and age. Delay in surgery was calculated by time between first ICD-9 code and CPT code. Poisson regression analysis was employed to look for significance of ACL injury rate trends. Logistic regression was employed to look for significant change in surgery rates. Linear regression was employed to look for significant change in delay in surgery.

RESULTS: Total patients enrolled in the insurance database within our study age range averaged 136,000 + 15,000/year. A total of 3303 ACL tears were identified. The overall rate averaged 121 + 19 per 100,000 person-years. The rate in males averaged 115 + 22 per 100,000 person-years. The rate in females averaged 128 + 24 per 100,000 person-years. All analyzed trends increased significantly over time except for the male 6-14 and 17-18 year old age groups. The overall incidence of ACL tears increased 2.3% per year. Males had an increase of 2.2% per year. Females had an increase of 2.5% per year. Females peaked at age 16 years with a rate of 392 ACL tears/100,000 person-years and males peaked at age 17 years with a rate of 422 ACL tears/100,000 person-years. The percent of ACL tears surgically reconstructed increased by 3% per year over the study period. The median delay in surgery was 28 days and decreased by 0.9% per year.

CONCLUSION: The incidence of ACL tears in young patients increased over the last 20 years. Both males and females had a large increase in incidence during high school years. The etiology of this is unknown; possible causes are increased sports participation and reaching skeletal maturity. This data will be helpful to target the most at-risk patients for ACL prevention programs.

Return to Play in Major League Baseball Pitchers Following Superior Labral Anterior Posterior Repair

Abstract ID: Paper 093

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INTRODUCTION: Baseball pitchers who undergo superior labrum anterior posterior (SLAP) repair often have trouble returning to their previous level of performance. The published return to play (RTP) rates for athletes who have undergone surgical repair of SLAP tears vary widely and are generally accepted to be lower in the subset of competitive throwers. The objective of this study is to examine the return to play and performance of MLB pitchers who have undergone SLAP tear repair.

METHODS: A retrospective review of Major League Baseball (MLB) pitchers undergoing SLAP repair from 2003 to 2010 was performed using the MLB disabled list (DL) and verified using popular sports websites. Performance metrics evaluated were: earned run average (ERA), walks plus hits per inning (WHIP), and innings pitched (IP). The average values for performance variables both prior to and after surgery were calculated. Subgroups of isolated labrum and labrum plus rotator cuff injury were established. Return to play was defined as pitching one full season in the MLB after surgery. A definition of return to prior performance (RTPP) was established as an ERA within 2.00 and WHIP within 0.500 of preoperative values.

RESULTS: Twenty-nine MLB pitchers met inclusion criteria. Of all 29 pitchers, 62.1% were able to return to play (RTP) after SLAP repair surgery. The average time spent on the DL before return was 316 days. Of the 18 pitchers that returned to play, 77.8% (14) had successful RTPP. Average performance analysis between subgroups of pitchers undergoing isolated SLAP repair compared with SLAP repair plus rotator cuff repair revealed no statistically significant differences in rate of RTP or average time on the DL ($p=0.644$, $p=0.450$).

DISCUSSION AND CONCLUSION: A 62.15% RTP is concerning in the context of these elite pitchers. However, the high RTPP rate among athletes that did return to play (77.87%) shows a good prognosis for players who are able to return. Although not statistically significant ($p=0.530$), there was a lower RTPP among labrum with rotator cuff repair (66.7%) compared with isolated labrum repair (80.0%). We believe this information highlights the need for improved surgical selection when treating MLB pitchers with SLAP tears. Identifying factors that can be used to predict successful return to play will greatly improve the surgical outcomes among these athletes.

PROMIS Compared to Traditional Patient Reported Outcome Measures in Patients With ACL Tears

Abstract ID: Paper 094

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INTRODUCTION: Patient-reported outcome (PRO) instruments allow providers to determine treatment efficacy; however, traditional instruments are often time consuming. With the intent to create a more efficient PRO instrument, the NIH developed the Patient Reported Outcome Measurement Information System (PROMIS) that employs Computerized Adaptive Testing (CAT). Previous investigators demonstrated that PROMIS is effective and less burdensome to patients with significant disability. However, they suspected a potential for ceiling effects in healthier populations. The purpose of this study was to compare PROMIS physical function CAT (PROMIS PF CAT) to traditional knee PRO instruments in a healthy population undergoing surgical treatment for ACL injuries. We hypothesized that the PROMIS PF CAT would show decreased test burden, significant ceiling effects, and a moderate to high correlation with current knee PRO instruments.

METHODS: Patients with ACL tears requiring surgical treatment were enrolled in the study after IRB approval. Each used the following PRO measures: Short Form-36 (SF-36); Knee Injury & Osteoarthritis Outcome Score (KOOS); Marx Knee Activity Rating Scale (Marx); PROMIS PF CAT. A Pearson or Spearman rank correlation test was used depending on data distribution. Statistical significance was defined as $p<0.05$. The following correlation categories were used: High (≥0.7), high-moderate (0.61-0.69), moderate (0.4-0.6), moderate-weak (0.31-0.39), weak (≤0.3). Floor/ceiling effects were considered significant if ≥15% of patients reported the lowest/highest possible score respectively. Test burden was measured as total items completed.

RESULTS: 36 patients were enrolled: 22 males, 14 females with an average age of 27 years (12-47). PROMIS PF CAT showed moderate correlation ($p<0.05$) with select traditional knee PRO instruments (Table 1). The Marx was the only PRO instrument that showed significant ceiling effects (33.3%), all others showed none (0%). The mean number of items completed for the PROMIS PF CAT was 4.0 (median 4; range 4-5).

DISCUSSION: The PROMIS PF CAT showed low question burden compared to traditional knee PRO instruments, but showed only moderate correlation and, therefore, may not be a reasonable alternative in this population. In contrast to previous investigator's suspicions, the PROMIS PF CAT showed no ceiling effects in this healthy patient population. The development of a lower-extremity-specific PROMIS domain may further increase its validity compared to traditional knee PRO measurements. Click here to view Table 1

Outcomes of Primary Reverse Shoulder Arthroplasty in Patients With Morbid Obesity

Abstract ID: Paper 095

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PURPOSE: Obesity has shown to be an important risk factor for worse outcomes in anatomic shoulder arthroplasty. However, there is a paucity of literature regarding the effect of obesity in reverse shoulder arthroplasty (RSA). The purpose of this investigation was to determine outcomes of primary reverse shoulder arthroplasty in patients with morbid obesity.

METHODS: We reviewed all primary RSAs performed on morbidly obese (BMI ≥ 40) patients from 2005 to 2012 at our institution with at least 2 years of follow-up. Forty-two patients were included in the study. 60% were female, their mean BMI was 44, and their mean age was 67.8 years.

RESULTS: There was one intraoperative complication, involving an inferior glenoid fracture that remained stable after glenosphere implantation. Humeral components were placed in 26 +/- 5° of retroversion. No glenospheres were placed with increased offset to compensate for body habitus. The average surgical and anesthesia times were 106 +/- 41 and 195 +/- 56 minutes. At a mean follow-up of 3.2 years (2-7.36), 3 (7%) patients required revision surgery for dislocation (1), infection (1), and humeral loosening (1). The 2- and 5-year survival were 95% and 90%, respectively. Additional postoperative complications included ulnar neuropathy (1) and heterotopic ossification (1). Pain relief was excellent, with 93% reporting moderate or severe pain preoperatively compared to 2% postoperatively ($p<0.001$). Shoulder abduction and external rotation improved from 47° and 17° to 141° and 50° ($p<0.001$). 93% were satisfied and felt their shoulders improved postoperatively. ASES, simple shoulder test, and shoulder subjective test scores were 71.1, 6.8, and 67.5, respectively. At most recent follow-up, no patients had glenoid lucency, while 1 (2%) had humeral lucency and 2 (5%) had inferior scapular notching. Patients who worked as laborers (farmers) had slightly higher risk for revision surgery ($p=0.08$), and female patients had worse functional outcomes and shoulder motion ($p<0.02$).

SUMMARY POINTS: RSA is a successful procedure in morbidly obese patients (BMI≥40). At intermediate follow-up, there is good implant survival with a reasonable complication rate and excellent pain relief.

Validation of Virtual Arthroscopy Simulation With Knee, Shoulder, and Virtual Fundamentals of Arthroscopic Surgery Training (FAST) Modules

Abstract ID: Paper 096

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INTRODUCTION: Orthopedic resident education has undergone evolution as a result of work hour restrictions and case requirements. Altered curricula have emphasized technical adjuncts to operating room instruction. The increasing use of simulators necessitates further analysis of this modality. We present a construct validation of a virtual arthroscopy simulator and analysis of available aptitude metrics. We also investigate the use of the Virtual Fundamentals of Arthroscopic Surgery Training (FAST) module, an environment for learning basic arthroscope skills.

MATERIALS AND METHODS: Following IRB approval, 30 orthopedic residents (PGY) 1-5 and 3 orthopedic faculty underwent a standardized simulator program including non-anatomic FAST exercises and a standard diagnostic knee and shoulder evaluation. Composite skill metrics were derived from simulator data, including task time, accuracy, camera path length, and simulated cartilage injury. ACGME case log record of arthroscopy cases were retrieved for all trainees. Univariate analysis was used to correlate mean simulator skill metrics, PGY, and arthroscopy cases performed. R^2 values are reported.

RESULTS: *FAST*: “Telescoping” was the simulator introduction task. Then, “Periscoping,” “Trace the Lines,” and “Gather the Stars” were used as FAST assessments. Training level (0.86) and total cases (0.76) correlated strongly with mean total score for “Trace the Lines.” Training level (0.67) and total cases (0.42) correlated moderately with mean total score for “Periscoping.” *Knee*: Mean simulator score metrics correlated strongly with postgraduate level for total score (0.88), economy score (0.88), time (0.87), and path length (0.94). Number of arthroscopy cases also correlated strongly with mean total score by year (0.76), economy (0.75), time (0.75), and camera path length (0.83). *Shoulder*: Mean simulator score metrics correlated strongly with postgraduate level for total score (0.78), time (0.87), and camera path length (0.74). Arthroscopy cases also correlated strongly with mean total score by year (0.76) and time (0.62), and moderately with camera path length (0.42). Faculty total scores were significantly different from pooled PGY 4-5 residents for knee ($p = 0.04$), shoulder ($p = 0.01$), and “Gather the Stars” ($p = 0.01$).

DISCUSSION: The aims of this study are threefold: to demonstrate the value of simulators in resident education; to compare skill metrics; and to validate FAST. Strong correlations between training level, cases performed, and different skill metrics across exercises suggests a realistic and valid arthroscopy construct. The total composite score consistently outperformed discrete metrics. A preliminary look at FAST supports its use as an arthroscopy adjunct.

Radiostereometric Evaluation of Tendon Elongation After Distal Biceps Repair

Abstract ID: Paper 097

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INTRODUCTION: Operative repair of distal biceps tendon ruptures have shown successful outcomes. However, little is known about the amount of tendon or repair site lengthening or creep. Treatment algorithms in regards to repair fixation, immobilization, initiation of activity, and physical therapy are largely made on previous tendon healing principles and anecdotal findings. The purpose of our study was to evaluate distal biceps tendon repair via intratendinous radiostereometric analysis to evaluate tendon lengthening/creep at different time intervals of healing.

METHODS: Patients were recruited with distal biceps rupture requiring operative repair. Distal biceps repairs were performed using an endobutton, single incision technique. Intraoperatively, two 2-mm tantalum beads with laser-etched holes were sutured to the distal biceps tendon. One bead was placed at the radius tendon interface and the other placed 1 cm proximal. Beads were evaluated via both CT scans immediately postoperatively and at 16 weeks and x-rays obtained at time 0 and at 4, 8, and 16 weeks. Measurements were made using the endobutton to bead and bead-to-bead distances in order to assess repair site elongation as well as tendon elongation over time. Following final follow-up, patients underwent a DASH questionnaire and ultrasound to confirm the integrity of the tendon.

RESULTS: Ten patients were included in the study. Nine patients had complete ruptures with one having a partial rupture that underwent completion and subsequent repair. All patients showed statistically significant lengthening after surgery. The mean amount of lengthening after surgery was 21.8 mm (range 10.1-29.7 mm, $p<0.05$). The repair site lengthened a mean of 12.5 mm (range 8.8-17.0 mm, $p <0.05$) and the tendon lengthened a mean of 9.4 mm (range: 4.0-18.8 mm, $p<0.05$) from surgery to final follow-up. The greatest change in lengthening was noted between time 0 and week 4 (mean: 11.8 mm, range: 4.0-18.0 mm, $p<0.05$), with the least amount of lengthening between week 8 and week 16 (mean: 3.6 mm, range: 2.1-5.5 mm, $p<0.05$). Average DASH scores after surgery was 4.5 (range: 2.5-16.7). Final ultrasound evaluations found no re-ruptures in any of the patients.

CONCLUSION: This study's findings suggest that all patients undergoing distal biceps tendon repair have significant elongation of their repair site and tendon after surgery, with the greatest amount of lengthening seen in the early postoperative period. These findings lend insight into decision-making with regards to intraoperative repair fixation and postoperative activity protocols while also adding knowledge to overall tendon repair principles.

Assessing the Incidence of PCL Plus Popliteus Injuries

Abstract ID: Paper 098

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BACKGROUND: Historically, PCL grade I and II injuries have been treated nonoperatively with good functional results, while the treatment of grade III PCL injuries is more controversial. It has been reported that the majority of PCL injuries undergoing operative management have concomitant ligament injuries. The popliteus and PCL act in synergy to prevent external rotation and posterior translation of the tibia. The most common cause of PCL failure is unrecognized associated PLC injury due to increased forces placed on the PCL. The PCL injuries commonly discussed are LCL or lateral structures, but do not specify which structures are being repaired or reconstructed. The aim of this study is to highlight the management of grade III PCL injuries with a new novel description called the PCL plus, which is a PCL and popliteus injury.

We hypothesize that an isolated grade III PCL injury may not frequently exist, rather an undiagnosed and untreated concurrent popliteus injury can lead to less successful outcomes.

METHODS: The cohort consisted of 38 patients and knees that were treated at our institution from 1/1/2005 through 12/31/2014 by the senior author. Data was prospectively gathered and retrospectively reviewed and extracted from a mulitiligamentous knee injury database. Inclusion data included patients who underwent a PCL reconstruction and a minimum of one year follow-up. Exclusion criteria included: an associated ACL injury, insufficient documentation.

RESULTS: 38 patients and knees met inclusion criteria. All patients had grade III posterior drawer on physical examination. 89.5% (n=34) of these patients had an associated popliteus injury. MRI findings were reviewed with respect to the popliteus and of those with an MRI (n=24). 63% either had no comment or incorrectly stated it was intact. Of the 4 knees without a popliteus injury, all had medial meniscal tears. Complications included 5% (n=2) with recurrent instability and underwent revision surgery.

CONCLUSIONS: In the setting of grade III PCL injury, there is a high incidence of popliteus injury that is commonly missed on imaging. The clinician must have a high suspicion for this injury pattern.

Osteochondral Autograft Transfer Achieves Higher Activity Level and Lower Failure Rates Than Microfracture in the Knee: A Meta-Analysis

Abstract ID: Paper 099

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OBJECTIVE: Though reparative techniques such as microfracture (MFX) and osteochondral autograft transfer (OAT) are available to treat small cartilage lesions, there is little data comparing the two techniques. The purpose of this meta-analysis was to compare MFX and OAT with respect to postoperative activity level and function, subjective patient outcome, and failure rates, and also to assess if any lesion characteristics favored one technique over the other.

METHODS: A comprehensive review of literature was performed for all studies comparing microfracture and osteochondral autograft transplantation. Studies included were all level 1 studies which reported on activity-based outcome measures such as Tegner or Marx activity scores, subjective outcomes with IKDC score, and functional outcomes scores. Failure rates and return to activity rates, as determined by the publishing authors, were recorded for each study. Meta-analyses were conducted using a random-effects model. Paired standardized mean differences (Hedges' g to account for small sample bias) were used for continuous outcome measures, and risk ratios (Mantel-Haenszel method for small sample bias) for dichotomous outcome measures.

RESULTS: Seven studies satisfied our eligibility criteria and included 249 patients (150 male, 98 female) with an average age of 26.8 years and follow-up of 67.2 months. Tegner scores were superior in patients treated with OAT compared to MFX (ΔOAT-MFX for pre-post scores=0.94 Tegner points, SMD=0.469, $p<0.01$, Figure 1). Failure rates of MFX were higher than OAT (OAT=11%, MFX=32%, RR=2.42, $p<0.05$, Figure 2). Return to activity and subjectively reported scores showed no difference between MFX and OAT at any time point. When assessing OAT lesions larger than 3 cm^2, OAT was superior to MFX with respect to activity level (SMD=0.506, $p<0.005$). When comparing studies with only OCD lesions to studies with both OCD and articular lesions, there was no difference in OAT and MFX with respect to any outcome measures.

CONCLUSION: Overall, OAT is superior to MFX with patients achieving a higher activity level and lower clinical failure rate. Larger lesion size improves the outcome of OAT over MFX for treatment of cartilage defects in the knee.

Click here to view Figure 1

Click here to view Figure 2

MAOA BREAKOUT SESSION #8
SPINE
April 15, 2016

Geriatric Cervical Spine Trauma and Blunt Cerebrovascular Injury: Liberal Screening Justified?

Abstract ID: Paper 100

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Introduction: Screening criteria for blunt cerebrovascular injury (BCVI) are included in trauma center protocols across the country to detect potentially morbid vertebral and carotid artery injuries. Although most are clinically silent, BCVI can be devastating leading to transient ischemic attack, vertebral artery thrombosis, stroke or death. Fractures from the occiput to C3, facet subluxations and fractures involving the transverse foramen have been shown to increase the risk of BCVI, but the majority of these studies included young patients with high injury severity scores. Geriatric patients (age >65) are known to be at risk for insufficiency fractures and may have cervical spine injuries that meet criteria for BCVI screening despite a considerably low energy mechanism of injury. Additionally, the recommended screening method of computed tomography angiography (CTA) of the neck introduces the risk of contrast-related complications in a potentially susceptible older patient population given medical co-morbidities. The aim of this study is to examine the incidence of BCVI with concurrent cervical trauma in geriatric patients while characterizing screening risk factors.

Methods: A retrospective review of prospectively collected data from the institutional trauma registry identified patients at a Level-I Trauma Center who underwent CTA of the neck between January 1, 2011 and June 30, 2014. Cervical fracture patterns, patient characteristics and serum creatinine values were recorded. Contrast-related nephropathy (CIN) was defined as a 25% increase from baseline creatinine or an absolute .5 mg/dL increase. Patients with pre-existing renal disease were excluded.

Results: Of 157 patients meeting inclusion criteria, 3 (1.9%) had a BCVI: one patient from the study group (age >65) and two from the control group (age <65). There was no significant risk of CIN in the study group (8.9%) compared to controls (7.4%, RR 1.21, p=0.75). 116 of 157 patients had a cervical fracture, of which occiput to C2 (n=69) and peripheral fractures involving the facet, lateral mass, or transverse process (n=64) were the most common. Subgroup analysis found 0 BCVI in 15 type II odontoid insufficiency fractures.

Discussion: To our knowledge, this is the first study looking at serial creatinine values in the setting of BCVI screening. There was no increased CIN risk in patients over the age of 65 (RR 1.21, p=0.75). 3 of 157 patients (1.9%) had a BCVI, consistent with reported rates in the

literature. BCVI screening in the geriatric population potentially requires reevaluation given current emphasis on value and patient outcomes in healthcare.

Inter/Intra-Observer Reliability of T1 Pelvic Angle (TPA), a Novel Radiographic Measure for Global Sagittal Deformity

Abstract ID: Paper 102

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OBJECTIVES: To assess intra- and inter-observer agreement of the T1 Pelvic Angle (T1PA), a novel radiographic measure of spinal sagittal alignment in a large consecutive series of healthy adults with no known spinal deformity or condition. Furthermore, we assessed the relationship of this novel measure, T1PA, to pelvic position.

BACKGROUND: Recent theory suggests that the T1PA is a more reliable measure of global sagittal alignment over traditional measurements. However, previous research focuses only on postoperative patients with known spinal deformity. Conclusions and targets for treatment using the T1PA are based on correlations with health related outcomes and quality of life measures. To date, there is no research on healthy subjects. The purpose of this study is to assess the reliability of this measurement in a population with no pre-existing spinal disorder and examine its relationship to pelvic position.

METHODS: Seven observers of varying orthopedic experience measured the T1PA in 50 consecutive healthy adults in each of three pelvic positions: neutral, anterior, and posterior. After a washout period of 4 weeks, the measurement was repeated on each radiograph. Using intraclass correlation coefficients (ICC), the intra- and inter-rater agreement for the T1PA was analyzed. The data was also used to determine the accuracy of this measurement and its relationship to pelvic position.

RESULTS: There was a very high level of agreement in all measurements of the T1PA, ICC $r=0.98$. At each pelvic position, all examiners had excellent intra-observer reliability >0.85. In comparison to a gold standard (measurements made by an expert fellowship-trained spine surgeon), examiners consistently measured the T1PA within $\pm 2°$. Furthermore, the data shows that the T1PA changes with pelvic position, $p<0.001$.

CONCLUSIONS: The T1 Pelvic angle is a reproducible and reliable measure of global sagittal alignment. Each observer accurately and consistently measured the T1PA, regardless of his or her level of training. Furthermore, it is evident that the T1PA varies based on pelvic position, and therefore this must be taken into account when assigning an absolute target for correction.

IL1-β Downregulates Canonical WNT Signaling Within the Intervertebral Disc via an NF-κB Dependent Process: Implications for the Pathogenesis of Intervertebral Disc Degeneration

Abstract ID: Paper 103

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INTRODUCTION: Intervertebral disc degeneration involves upregulation of inflammatory and pro-catabolic signaling cascades within the intervertebral disc (IVD). Alternatively, developmental signaling processes, such as the canonical WNT/beta-catenin cascade, may contribute to protection and maintenance of the nucleus pulposus cellular phenotype. A relationship between inflammation within the IVD and alterations in canonical WNT/beta-catenin signaling has not been established. Herein, a murine ex-vivo IVD organ culture model was used to mechanistically investigate the effects of inflammatory mediated signaling on the canonical WNT/beta-catenin pathway within the IVD.

METHODS: Murine IVD explants were extracted from wild-type and TOPGAL (WNT reporter) mice and cultured. Explants were treated with IL1-ß at 10ng/mL or 100ng/mL for 12 and 24 hours. Real-time quantitative PCR and immunoblot analysis was used to assess induction of a pro-catabolic state and alterations in canonical and non-canonical WNT signaling in response to IL1-ß. NF-κB blockade was accomplished by treating IVDs with IKKg NEMO Binding Domain Inhibitory Peptide. Cultured human IVD nucleus pulposus disc tissue was also utilized.

RESULTS: IL1-ß treatment results in significant upregulation of ADAMTS4 and MAPK and downregulation of COL2 and ACAN consistent with a degenerative, pro-catabolic phenotype. IL1-ß treatment also resulted in statistically significant, dose-dependent downregulation of AXIN2 indicating a decrease in canonical WNT signaling. Treatment of TOPGAL mice IVDs with IL1-ß reduced expression of LACZ in a dose-dependent manner, further supporting the inhibitory effect of IL1-ß on WNT signaling. Pretreatment of murine IVDs with IKKg NEMO Binding Domain Inhibitory Peptide, which prevents nuclear translocation of NF-κB, reversed the inhibitory effects of IL1-ß on canonical WNT/beta-catenin signaling, indicating that downregulation of canonical WNT signaling is a NF-κB dependent process. Interestingly, IL1-ß treatment demonstrated an increase in the non-canonical WNT signaling pathway, by upregulating WNT5a expression. NF-κB signaling blockade resulted in WNT5a gene expression returning to levels consistent with untreated controls. For human corollary data, cultured nucleus pulposus cells were treated with IL1-ß. Treatment resulted in significant decrease in AXIN2 and significant increase in WNT5a gene expression, corroborating our murine data.

CONCLUSION: Our results demonstrate that inflammatory signaling in murine IVDs decreases canonical WNT/beta-cantenin signaling while simultaneously upregulating non-canonical WNT signaling, via a NF-κB dependent process. IL1-ß treatment of human tissue causes similar IL1-ß induced WNT signaling changes as murine IVDs. As WNT signaling may contribute to maintaining the nucleus pulposus cellular phenotype, our results may help to elucidate the pathogenic mechanism of inflammatory induced degeneration in the IVD.

Assessment of Sacroiliac Joint Dysfunction With Intensity Pain Mapping in Patients With Spinopelvic Fixation

Abstract ID: Paper 104

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INTRODUCTION: Two commonly used techniques of pelvic fixation are the iliac screws (IS) method, and the more recently described S2 alar iliac (S2AI) method. A valid concern of the S2AI method is that the S2 screw violates and crosses the SI joint - the long-term implications of which are unknown. Our study aims to compare the pain generated from the SI joint from these two techniques. We elected to utilize general and regional intensity pain mapping to assess SI joint dysfunction in our patients. We developed our SI joint pain assessment method based on validated studies in the current literature.

METHODS: Participation in this survey entailed mailing in two completed pain maps. The first map entailed a full body pain diagram. The second map (Figure 1A) is a map of the gluteal region. In this map, patients were instructed to select the region of their most severe pain with a maximum of 5 boxes on each side. The regional map was divided into 3 zones (Figure 1B). The amount of checked boxes in each zone was recorded. We calculated the percentage of each patient's pain that was in each zone. We delineated Zone 2 on Figure 1B as the region most likely indicative of SI joint dysfunction.

RESULTS: We received a 42% (13/31) and a 69% (18/26) survey response rate from the iliac screws and S2AI groups, respectively. All patients had a 2-year minimum follow-up time. 22.2% of S2AI patients and 7.7% of IS patients indicated 50-75% of their pain was in Zone 2 ($p=0.285$). 33.3% of S2AI patients and 30.8% of IS patients indicated 75-100% of their pain in Zone 2 ($p=0.597$). In summing these groups, we found 55.6% of S2AI patients and 38.5% of IS patients found 50-100% of their pain in Zone 2 ($p=0.283$).

DISCUSSION AND CONCLUSION: We found no statistically significant difference between the S2AI and IS groups in the percentage of pain that was located in a region likely to represent SI joint pain (Zone 2), whether we set the threshold at 50% or 75% of pain localization. Our findings are clinically significant because they demonstrate that the S2AI method is not associated with SI joint pain despite the involvement of the S2AI screw violating the SI joint.

Click here to view Figure 1

Sleep Disturbances Associated With Lumbar and Cervical Spine Radiculopathy

Abstract ID: Paper 105

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INTRODUCTION: Lumbar and cervical spine radiculopathy can have a tremendous effect on patients' quality of life. However, the effect of lumbar and cervical radiculopathy on patients' sleep quality has not been investigated. The purpose of this study was to examine the quality of sleep in a cohort of patients that have been diagnosed with lumbar or cervical radiculopathy, and to determine if sleep quality correlates with patient-perceived health.

MATERIALS/METHODS: We distributed questionnaires to all patients found to have clinical and radiographic findings consistent with a diagnosis of lumbar or cervical radiculopathy in the outpatient orthopedic spine clinic of a large urban hospital during a two-month period. The questionnaire given to assess sleep quality was the Pittsburgh Sleep Quality Index (PSQI). We also distributed the Short Form 36 (SF-36) to quantify patients' perceived health with regards to their diagnosis. Demographic data and diagnosis (lumbar vs. cervical radiculopathy) were also recorded for each patient. Statistical analysis was performed to determine any correlation between the PSQI score to the SF-36 score, and also to reveal any predictive factors for poor sleep quality.

RESULTS: 98 patients completed questionnaires, 75 patients with lumbar radiculopathy and 23 patients with cervical radiculopathy. Statistical analysis using Pearson correlation coefficients and p- values was obtained from the completed questionnaires. The overall prevalence of sleep dysfunction was 98% (PSQI>5). 79 patients (81%) had PSQI global score of >10 which is similar to a level of sleep disturbance of patients with clinical depression. 40 patients (41%) had severe sleep disturbance with PSQI global score of >15. Age and sex were not statistically correlated with sleep dysfunction in radiculopathy. Every sub-scale of the SF-36, as well as the physical and mental composite scores were negatively correlated with PSQI global score ($p<.001$), except the role-physical (RP) sub-scale. The sub-scale with the greatest negative correlation with PSQI global score was Bodily Pain (BP).

DISCUSSION: Sleep disturbance is an extremely common problem in patients with lumbar and cervical radiculopathy. Sleep quality in patients with radiculopathy does correlate with patient-perceived outcome. More investigation needs to be performed to ensure improvement of sleep dysfunction after intervention for radiculopathy.

Medicare's Hospital Acquired Conditions Policy: A Problem of Non-Payment After Spine Deformity Surgery

Abstract ID: Paper 106

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INTRODUCTION: In 2008, the Centers for Medicare and Medicaid Services (CMS) adopted a policy of non-payment for inpatient Hospital Acquired Conditions (HACs), but the epidemiology of HACs after spine surgery has not been previously explored. Thus, the purpose of this study was to explore the incidence of, risk factors for, and national costs of HACs after spinal deformity surgery.

METHODS: The 2007–2011 Nationwide Inpatient Sample (NIS) was queried for patients between ages 30-95 undergoing elective spinal fusion. International Classification of Disease-9th Revision (ICD-9) codes were used to define diagnostic groups and the presence or absence of HACs. Bivariate analysis was used to compare patient, case, and hospital characteristics in those with and without a HAC, and multivariate analysis was used to identify independent risk factors. The incidence of HACs in other common spinal conditions (degenerative disc disease [DDD], spinal stenosis, spondylolisthesis, trauma, and metastasis) was also calculated to serve as a comparison for the deformity patients.

RESULTS: In total, 1.7 million cases of spinal fusion were identified between 2007 and 2011. Of those, 8.5% or 144,235 cases were done for spinal deformity. The incidence of HACs was 2.11% for the entire cohort, lowest among patients diagnosed with DDD at 1.14% and highest among spinal deformity patients, 4.52%, and metastatic disease 5.08% ($p<0.001$). In spinal deformity patients, the average hospital LOS (4.9 vs. 10.0 days, $p<0.001$), and mean hospital charges/costs ($208,028/$72,155 vs. $140,040/$49,360, $p<0.001$) were higher in patients with a HAC. In 2011 alone, HACs resulted in a potential loss of greater than $6 million in reimbursements. The risk factors for developing a HAC included, advanced age ($p<0.001$), white race ($p=0.01$), and hospitals in the south ($p=0.001$).

CONCLUSION: The incidence of Hospital Acquired Conditions after adult spinal deformity surgery is not insignificant, at 4.5%. Patients experiencing a HAC incur nearly twice the hospital LOS, and 50% higher costs. Non-payment for these surgical complications has significant financial implications. The NIS database was used to analyze 144,235 cases of adult spinal deformity surgery for the presence of Hospital Acquired Conditions (HACs), as defined by CMS. The government has adopted a policy of non-payment for inpatient HACs. We define the incidence, risk factors, and national costs for HACs after spinal deformity surgery.

Prevention of Proximal Junctional Kyphosis/Failure Using Sublaminar Bands in a Hybrid Construct in Pediatric Kyphosis Deformity

Abstract ID: Paper 107

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SUMMARY: Sublaminar polyester bands in a hybrid construct in the proximal end of the spinal deformity is a safe technique that helps prevent the development of PJK and PJF.

HYPOTHESIS: Rates of PJK after PSF is performed with our technique will have a lower rate of PJK than previously reported with other methods of fixation.

DESIGN: This is a retrospective review of pediatric spinal deformity cases from January 2008 to December 2012. Inclusion criteria for this study includes patients with a kyphosis greater than 60° treated surgically utilizing sublaminar polyester bands in a hybrid construct at the proximal end of the deformity with minimum of 2 years of follow-up. Outcome measures were based on pre- and postoperative radiographic criteria and clinical symptoms during outpatient follow-up.

INTRODUCTION: Proximal junctional kyphosis (PJK) and proximal junctional kyphosis (PJF) are common complications after posterior spinal fusion for kyphotic deformity correction. Research has suggested multiple potential etiologies for this complication, including the rigidity of the surgical construct and the disruption of posterior ligamentous attachments during surgical dissection. The purpose of this study was to evaluate mid-term PJK/PJF rates and clinical outcomes, in patients that underwent posterior spinal fusion (PSF) and deformity correction using sublaminar bands in a hybrid construct.

METHODS: This is a retrospective review of patients that underwent PSF with use of sublaminar bands by a single surgeon. 136 spinal deformity cases were reviewed from January 2008 to December 2012 in which 17 cases met inclusion criteria (kyphosis deformity greater than 60°, sublaminar band hybrid technique). PJK was defined as proximal junction sagittal cobb angle (PJA) of at least 10° greater than the preoperative measurement. This was assessed by comparison of preoperative xrays and in-hospital postoperative x-rays to x-rays obtained at least 2 years later during outpatient follow-up.

RESULTS: Minimum duration of follow-up was 2 years. The range of the preoperative kyphosis was 62°-111°, and postoperative kyphosis was 12°-55°. There was one case of PJK (5.8%) and no cases of PJF.

CONCLUSION: This study on mid-term outcomes of PSF using sublaminar bands for treatment of kyphosis demonstrated a lower rate of PJK than has been reported in prior studies. This technique decreases the rigidity of the construct resulting in a smoother transition between fused and unfused segments.

Clotting Kinetics During Extensive Spinal Deformity Surgery: Preliminary Thromboelastography (TEG) Results

Abstract ID: Paper 108

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SUMMARY: Clotting kinetics was studied with thromboelastography (TEG) in 11 patients undergoing spinal deformity surgery. Only patients without tranexamic acid (TXA) infusions showed a trend towards hyperfibrinolysis. This observation mimics that of trauma patients, where a Protein-C mediated increase in t-PA activity is responsible for accelerated clot breakdown.

HYPOTHESIS: Patients that undergo prolonged spinal deformity surgery develop coagulopathy secondary to hyperfibrinolysis.

DESIGN: Prospective observational study.

INTRODUCTION: Spinal deformity surgery involves massive surgical dissection and prolonged surgical time, resulting in extensive endothelial injury, major fluid shifts, and dilution of coagulation factors. Acute coagulopathy is seen, akin to that of trauma patients. The purpose of this research is to study clot kinetics in patients undergoing major spinal surgery.

METHODS: Eleven adult patients subject to spinal deformity surgery were included: six with (TXA) and five without (non-TXA) tranexamic acid infusion. Thromboelastography (TEG) at baseline and every 2 hours; Fibrinolysis (Ly30) and clot strength (MA) were compared (mean [95%CI]).

RESULTS: TXA vs. non-TXA groups were comparable in age (62.0 [47.0-77.0] vs. 64.4 [56.7-72.1], p=0.81); BMI (27.3 [22.8-31.8] vs. 32.6 [28.6-36.6], p=0.15), surgical time (10.5 hours [9.9-11.2] vs. 9.9 [7.3-12.4], p=0.68); EBL (2.2L [1.4-3.0] vs. 2.5 [1.5-3.4], p=0.72) and PRBC transfusions: (3.8 units [3.0-4.7] vs. 4.4 [2.3-6.5] p=0.72). There were no significant differences between baseline and final TEG samples. The following trends were observed with surgical time: Clot strength decreased from 8.0 (5.9-10.1) to 6.9 (1.9-8.9) in TXA group vs. 10.2 (7.8-12.6) to 7.1 (5.4-8.9) in non-TXA, F=0.162. Ly30 decreased in TXA group from 1.5% (-0.01-2.9) to 0.4% (0.1-0.6) while it increased from 0.8% (0.2-1.5) to 2.6% (0.1-5.1) in non-TXA, F=0.364.

CONCLUSION: Although no patients developed Ly30 values reflecting hyperfibrinolysis (>7.5%), only the non-TXA group demonstrated a trend towards this. These patients also showed a more substantial decrease in clot strength. Further work is being conducted to determine who is at risk for hyperfibrinolysis.

Factors Influencing Discharge Status and Length of Stay Following Cervical Vertebral Fracture

Abstract ID: Paper 109

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INTRODUCTION: Vertebral fractures are a significant cause of inpatient hospitalization. The aim of this study was to elucidate patterns of healthcare resource usage and identify risk factors for prolonged hospital stay and non-routine discharge.

METHODS: National Hospital Discharge Survey (NHDS) database data was searched using ICD-9 diagnosis and procedure codes for patients admitted with closed cervical vertebral fractures without spinal cord injury from the years 2001-2010. Primary outcomes of interest were discharge disposition, length of stay, and mortality. Outcomes were compared with regard to patient demographics, hospital and payment type, and various medical and surgical comorbidities. Subgroup analysis was made by fracture level. Statistical analysis was made using multivariate linear and logistic regression, student's t-test, and chi-squared test with a significance level of 0.05.

RESULTS: In the years 2001-2010, 1944 closed cervical vertebral fractures were reported in the NHDS database. 43% were C1 and C2 fractures, 53% were sub-axial cervical fractures (C3 through C8), and 4% were non-specified. 15% of fractures required operative intervention. C1/C2 fractures required operative intervention 9% of the time, while there was a 21% incidence of operative procedures on sub-axial cervical fractures. Factors associated with longer length of stay were male sex, atrial fibrillation, femoral fracture, DVT, and operative spinal fusion ($p<0.05$). Private insurance was associated with shorter length of stay ($p<0.05$). Factors associated with increased risk of mortality were age and need for blood transfusion ($p<0.01$). Risk factors for non-routine discharge were age, male sex, femoral fracture, need for blood transfusion, and public insurance ($p<0.01$). Operative spinal fusion was associated with reductions in both mortality and non-routine discharge ($p<0.05$).

DISCUSSION/CONCLUSIONS: Although a causal relationship cannot be established by the current study, these data highlight several important factors associated with increased mortality, morbidity, and healthcare resource utilization and help provide a framework for further inquiry. The association of operative intervention with decreased rates of both mortality and non-routine discharge may merit further investigation.

Analysis of a Ten Step Protocol that Decreased Postoperative Spinal Wound Infection

Abstract ID: Paper 110

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INTRODUCTION: There have been several reports of various measures to reduce incidence of surgical site infection following spine surgery. Although several single measures have been evaluated in the literature, few reports have controlled for more variables. The purpose of the current study was to define a ten-step protocol that reduced the incidence of surgical site infection in the spine surgery practice of the senior author and evaluate the support for each step based on current literature.

MATERIALS AND METHODS: In response to unexplained increased infection rates at our institution following spine surgery, a ten-step protocol was implemented: (1) Preoperative glycemic management based on hemoglobin A1c (HbA1c), (2) Skin site preoperative preparation with 2% chlorhexidine gluconate disposable cloths, (3) Limit operating room traffic, (4) Cut the number of personnel in the room to the minimum required, (5) Absolutely no flash sterilization of equipment, (6) Double-gloving with frequent changing of outer gloves, (7) Local application of vancomycin powder, (8) Re-dosing antibiotic every 4 hours for prolonged procedures and extending postoperative coverage to 72 hours for high-risk patients, (9) Irrigation of subcutaneous tissue with diluted povidone-iodine solution after deep fascial closure, and (10) Use of DuraPrep skin preparation at the end of a case before skin closure. Through an extensive literature review, the current data available for each of the ten steps was evaluated.

RESULTS: Use of vancomycin powder in surgical wounds, routine irrigation of surgical site, and frequent changing of surgical gloves are strongly supported by the literature. Preoperative skin preparation with chlorhexidine wipes is similarly supported. The majority of current literature supports control of hemoglobin A1c preoperatively to reduce risk of infection. Limiting the use of flash sterilization is supported, but has not been evaluated in spine-specific surgery. Limiting OR traffic and number of personnel in the OR are supported although without level 1 evidence. Prolonged use of antibiotics postoperatively is not supported by the literature. Intraoperative use of DuraPrep prior to skin closure is not yet explored.

CONCLUSIONS: The ten-step protocol defined herein has significantly helped in decreasing surgical site infection rate. Several of the steps have already been shown in the literature to have significant effect on infection rates. As several measures are required to prevent infection, instituting a standard protocol for all the described steps appears beneficial.

Shilla Growing Rods With Greater Than Five Years of Follow-Up: Curve and Implant Characteristics

Abstract ID: Paper 111

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The Shilla growth guidance system was designed to treat early onset scoliosis. It allows surgical correction of spinal deformities while still harnessing the child's remaining spinal growth and limits frequent surgeries to lengthen growing implants.

HYPOTHESIS: Curve characteristics will change over time after the initial apical fusion and placement of the Shilla implants. Rod fractures and screw pullout are an expected outcome in growing, active children.

METHODS: Retrospective review of all patients treated with the Shilla in place for 5 years or greater, total of 21 patients. Charts and radiographs were reviewed to compare coronal curve characteristics preoperatively, postoperatively, and at last follow-up noting changes in the apex of the primary curve. Development of adjacent compensatory curves, overall vertical spinal growth, the incidence of rod fracture and screw pullout, and the need for definitive spinal fusion vs. removal of the implant alone was reviewed.

RESULTS:
- 9 males and 12 female (n=21).
- Neuromuscular (n=8), Syndromic (n=7), Idiopathic (n=5), and Congenital (n=1).
- Average age at index Shilla procedure was 6 years + 8 months (range 1+11 to 11+10).
- Average length of time the implants were in place was 83.95 months.
- Apex of the primary curve moved 2 vertebral levels or greater in 13/21 patients with an average of 2.73 vertebral levels (range 2-5 levels).
- Apex shifted distally in 12 patients and proximally in 1 patient. 2 developed new compensatory curves.
- All patients demonstrated vertical spinal growth.
- 6/21 patients experienced 1 episode of rod fracture, and 3/21 patients experienced 2 episodes of rod fracture. 3/21 patients developed pullout of a pedicle screw.

CONCLUSION: This is the longest follow-up of patients with early onset scoliosis treated with the Shilla procedure. Results show the primary curve shifts in approximately 62% of patients with the majority of these involving a distal transition. All patients demonstrated continued spinal growth with an average increase in T1-S1 length of 45.5 mm of longitudinal growth. 11 patients had implant failures: 8 patients experienced rod fracture, 2 patients had screw pull out, and 1 patient experienced both. A better understanding of the long-term follow-up of Shilla patients will add to our fund of knowledge regarding this innovative growing spinal system.

Is There Any Role for Standard Growing Rod Instrumentation for the Treatment of Scoliosis in Spinal Muscle Atrophy?

Abstract ID: Paper 112

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INTRODUCTION: Scoliosis is the most common spinal deformity in patients with spinal muscle atrophy (SMA) and is typically progressive in nature, often resulting in severe deformity and negatively affecting pulmonary function. Although generally recommended for progressive deformity, the timing and method of surgical intervention remains controversial. The purpose of this study was to evaluate our 30-year experience of definitive posterior spinal fusion as treatment of scoliosis in SMA and determine the effects on pulmonary function, clinical complications, radiographic outcomes, and cost.

METHODS: All children with SMA and associated scoliosis that underwent posterior spinal fusion between 1985 and 2014 were reviewed retrospectively. Seventeen patients (6 male and 11 female) met the inclusion criteria and were included in the study. Three patients had SMA Type I, eight had SMA Type II, and five had SMA type III. All patients underwent posterior spinal fusion using Luque rod constructs. Radiographic data included direct measures of Cobb angle, coronal balance, pelvic obliquity, and T1-S1 length and estimations of rib collapse, thoracic cavity shape, and space-available-for-lung (T6:T12 width ratio, T6:T10 rib-vertebral-angle difference ratios, and lung height) was collected.

RESULTS: Posterior spinal fusion was performed at an average age of 9.7 ± 3.4 years. The mean age at most recent follow-up was 17.1 years (range 8-34 years), with a mean follow-up of 7.8 years (range 0.6-24 years). Radiographic measurements improved from preoperative to latest follow-up as follows: curve, 77° ± 20° to 26° ± 23°; coronal balance, 4.1 ± 4.0 cm to 1.8 ± 2.1 cm; pelvic obliquity (median), 23° to 5°; space-available-for-lung ratio, 0.93 ± 0.25 to 0.95 ± 0.24; and T1-S1 length grew 6.2 ± 5.8 cm. Rib collapse continued throughout the follow-up period in all but one patient yet the estimated thoracic cavity shape was maintained or improved in all but four patients. Length of stay was 7.7 ± 4.3 days. There were four perioperative complications. Mean cost of surgical admission (available for 10 patients since 2003) was $132,287 in 2015 dollars (range $76,814 to $196,560).

CONCLUSIONS: Definitive posterior spinal fusion for treatment of scoliosis associated with SMA is effective at controlling spinal curvature and pelvic obliquity without negatively impacting the space-available-for-lung ratio, trunk height, or pulmonary function at up to 24 years follow-up. Children are not exposed to the increased costs, hospitalizations, and additional medical and surgical risks associated with repeated encounters required for standard growing rod instrumentation and lengthening.

MAOA BREAKOUT SESSION #9
TOTAL KNEE ARTHROPLASTY
April 15, 2016

A Randomized Controlled Trial of Oral and IV Tranexamic Acid: The Same Efficacy at Lower Cost?

Abstract ID: Paper 113

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INTRODUCTION: Tranexamic acid (TXA) is a synthetic antifibrinolytic agent successfully used intravenously (IV) to reduce blood loss following total knee arthroplasty (TKA). An oral formulation of the medication is available, at a fraction of the cost of the IV preparation. The purpose of this randomized controlled trial is to determine if oral TXA is equivalent to IV TXA in reducing blood loss in TKA.

METHODS: In this double-blinded, placebo-controlled trial, 73 patients undergoing primary TKA were randomized to receive 1.95g of TXA orally two hours preoperatively or a 1g IV bolus prior to wound closure. The primary outcome was reduction of hemoglobin. Power analysis determined that 30 patients were required in each group to identify a 1.0g/dL difference between groups with an alpha of 0.05 and a beta of 0.90. Equivalence analysis was performed with pooled and Satterthwaite t-tests with a p-value of < 0.05 suggesting equivalence between treatments.

RESULTS: 36 Patients received IV TXA, 32 oral and 5 were excluded for protocol deviations. Patient demographics were similar between groups suggesting successful randomization. There was no difference in the mean reduction of hemoglobin between the oral and IV groups (3.45g/dL vs. 3.31g/dL respectively; $p<0.001$, equivalence). Similarly, total blood loss was equivalent for oral and IV administrations at 1267 ml vs. 1229 ml respectively ($p=0.007$, equivalence). One patient in each treatment group was transfused, and no patients experienced a thromboembolic event.

CONCLUSIONS: Oral TXA provides equivalent reductions in blood loss in the setting of primary TKA, at a cost of $14 compared to $47 to $108 depending on the IV formulation selected. As approximately 700,000 primary TKAs are performed in the United States annually, a switch to oral TXA could yield total cost savings of between $23 million and $67 million dollars per year for our health care system.

IV vs. Topical Tranexamic Acid in TKA: In a Randomized Clinical Trial of 600 Patients Both Effective

Abstract ID: Paper 114

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INTRODUCTION: Antifibrinolytics such as tranexamic acid (TA) reduce postoperative bleeding and the need for transfusion after total knee arthroplasty (TKA). Most literature has focused on IV TA and less data is available on the efficacy of topical TA. We designed this multi-center randomized clinical trial to specifically assess the efficacy of topical TA compared to IV TA as measured by total blood loss, drain output, and transfusion rates.

METHODS: 600 unilateral primary TKAs performed for osteoarthritis were randomized to 2 groups: (1) 1 g of IV TA upon incision and 1 g at closure or (2) 3 g of TA diluted in 75 mL normal saline and applied locally after cementation. Age, sex, BMI, ASA score, preoperative hemoglobin, and co-morbidities were similar between groups. Univariate, multivariate regression, and multiple logistic regression analyses were performed.

RESULTS: Patients receiving topical TA had significantly more blood loss compared to those receiving IV TA (409 mL vs. 306 mL; $p = 0.007$). Drain output was similar between the topical and IV TA groups (400 mL vs. 409 mL; $p = 0.8$). There was no significant difference in transfusion rates between the topical and IV groups (1.4% vs. 0.84%; $p = 0.99$).

DISCUSSION AND CONCLUSION: Both topical and IV TA were effective in minimizing total blood loss, drain output, and transfusion rates after TKA. Patients who received topical TA had slightly greater blood loss (100 mL), but this did not result in a significant increase in transfusions. As part of a contemporary blood management strategy, the use of either topical or IV TA was associated with transfusion rates less than 2% in this randomized trial.

SUMMARY: In this large randomized clinical trial of contemporary TKA, topical use of TA resulted in slightly higher blood loss, but similar drain output and transfusion rates (<2%) compared to IV TA.

Comparison of Tranexamic Acid and Epsilon-Aminocaproic Acid in Managing Blood Loss After Total Knee Arthroplasty

Abstract ID: Paper 115

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INTRODUCTION: Tranexamic acid (TXA) and epsilon-aminocaproic acid (EACA) are synthetic lysine-analogues that inhibit fibrinolysis. Both drugs have been shown to reduce blood loss and transfusion requirements with a minimal risk of thromboembolic complications after cardiac, vascular, and orthopedic surgery.[1-2] Yet compared to TXA, research on EACA is limited in the orthopedic literature. To date, only one published trial has compared the antifibrinolytic effects of EACA and TXA in total knee arthroplasty (TKA).[1-3] With this, the primary aim of this prospective, double-blind, randomized controlled trial is to compare the antifibrinolytic effects of TXA and EACA in TKA.

METHODS: A total of 140 TKA patients were randomized to receive TXA (n=72) or EACA (n=68) by permuted block randomization. Primary outcomes measures include: transfusion rates, drop in hemoglobin (HgB), serum creatinine change, and postoperative renal, thrombotic, and bleeding events.

Between-group differences in clinical and demographic variables were evaluated using independent-samples t-test and chi-square tests as appropriate. For both HgB and creatinine, between-group differences in change across study days and at each study day individually were evaluated using a multivariate repeated-measures ANOVA. SAS vs. 9.4 was used for all analyses; $p<.05$ was used to indicate statistical significance.

RESULTS: Demographic and clinical variables are presented in Table 1. For HgB and creatinine, no statistically significant between-group differences were observed in change over study days or at any individual measurement (Table 1). Finally, no between-group differences were indicated in either the rate of renal, thrombotic, and bleeding complications (10.29% for EACA vs. 6.94% for TXA, $p = 0.764$; Table 2) or the transfusion rate (0% in both groups).

DISCUSSION: No differences in all outcomes measures were observed between groups. In the sole previous comparison of TXA and EACA in TKA, both drugs were shown to reduce blood loss and transfusion requirements vs. a control. However, statistically significant differences between treatment groups could not be detected due to the limited number of participants, with 35 patients enrolled in the TXA group and 32 patients enrolled in the EACA group.[1] We conducted this prospective examination after recent shortage concerns of TXA and EACA. During shortages of TXA, we have administered EACA to TKA patients with no increases in bleeding complications at our institution. We can conclude EACA is an acceptable alternative to TXA for blood management in TKA.

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Click here to view Table 1

Click here to view Table 2

Bariatric Surgery Does Not Improve Outcomes in Patients Undergoing Primary Total Knee Arthroplasty

Abstract ID: Paper 116

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INTRODUCTION: The impact of body mass index (BMI) and obesity on the outcomes of total joint replacement is actively being investigated, with clear evidence that BMI and complications are directly proportional. In an attempt to decrease the perioperative complications associated with an increased BMI, some surgeons have recommended preoperative bariatric surgery. However, limited information is currently available to determine if there are any benefits for undergoing bariatric surgery prior to total knee arthroplasty (TKA). The purpose of this study was to compare the results of patients who underwent bariatric surgery prior to TKA with two separate matched cohorts; one cohort matched with higher pre-bariatric BMI and a second matched with lower pre-TKA BMI.

MATERIALS AND METHODS: Our institutional total joint registry was utilized to identify all primary total knee arthroplasties performed from 1998-2012 (n=12,852 knees). Of these, we identified a cohort of 91 TKAs that were performed following bariatric surgery (bariatric cohort). These knees were matched with two separate cohorts of patients with no history of bariatric surgery. One cohort was matched 1:1 with higher pre-bariatric BMI (high BMI group), and the other was matched 1:2 based on lower pre-TKA BMI (low BMI group). Aside from BMI, groups were also matched using sex, age (±4 years), and date of TKA (±4 years). Hazard ratios and 1- and 5-year Kaplan-Meier survival rates were determined for overall complication, reoperation, revision, and prosthetic joint infection rates.

RESULTS: The groups were similar in regards to patient sex, age, preoperative diagnosis, and mean follow-up. In the bariatric cohort, mean pre-bariatric BMI was 51.1 kg/m^2, which improved to 37.3 kg/m^2 at the time of TKA. Correspondingly, mean BMI was 51.2 kg/m^2 in the high BMI group and 37.2 kg/m^2 in the low BMI group. Patients in the bariatric cohort had a higher risk of, and worse survival free of, reoperation (HR 2.6, p=0.02) compared to the high BMI group. Furthermore, the bariatric group had higher risk of, and worse survival free of reoperation (HR 2.4, p=0.2) and revision (HR 2.2, p=0.04) compared to the low BMI group.

DISCUSSION: Bariatric surgery has been suggested as a means of improving outcomes following total knee arthroplasty in patients with morbid obesity. However, we found that even though BMI improved in these patients prior to TKA, the risks of reoperation and revision do not necessarily decrease accordingly. Furthermore, their reoperation rate may be higher than even patients with similarly high pre-bariatric BMI. While bariatric surgery did effectively lower the BMI in our patient population, more analysis is needed prior to recommending bariatric surgery as a method of optimization prior to TKA.

Validated Risk Stratification System for Pulmonary Embolism Following Primary Total Joint Arthroplasty

Abstract ID: Paper 117

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INTRODUCTION: Stratification of patients into different risk categories for pulmonary embolism (PE) following total joint arthroplasty (TJA) may allow clinicians to individualize venous thromboembolism (VTE) prophylaxis based on an appropriate risk-benefit scale. The purpose of this study was to categorize patients into different risk categories for PE following TJA.

METHODS: Patients undergoing primary total hip or knee arthroplasty (THA or TKA) as part of the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) were identified. Independent risk factors for PE within 30 days of surgery were identified. A point-scoring system to estimate the relative risk for PE was developed. For validation, the system was tested on patients undergoing TJA at a single institution, all of whom received warfarin prophylaxis.

RESULTS: 118,473 Patients were identified, including 72,673 (61.3%) undergoing TKA and 45,800 (38.7%) undergoing THA. The incidence of PE within 30 days of the index arthroplasty was 0.50%. The risk factors associated with PE were: age≥70, female gender, higher body mass index (25-30 kg/m^2 and ≥30 kg/m^2), and TKA (vs. THA); anemia was protective. The point scores derived for each of these factors were as follows: anemia -2; female +1; body mass index 25-30 kg/m^2 +2; body mass index ≥30 kg/m^2 +3; age≥70 years +3; TKA +5. The point scoring system was then applied to 17,384 patients from a single institution who had received warfarin prophylaxis. Single-institution patients categorized as low risk using the point scoring system had a 0.44% 90-day risk for PE (95% CI=0.29-0.58%); medium risk, 1.51% (95% CI=1.18-1.84%); and high risk, 2.60% (95% CI=2.09-3.10%).

CONCLUSIONS: Using the ACS-NSQIP, a point scoring system for the risk of PE following TJA was developed. This point scoring system was validated on patients from a single institution, all of whom received warfarin prophylaxis. This system may facilitate risk stratification and optimize selection of chemical prophylaxis.

Safety and Efficacy of Topical Tranexamic Acid in Patients With Increased Thromboembolic Risk Undergoing Total Knee Arthroplasty

Abstract ID: Paper 118

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INTRODUCTION: The use of Intravenous Tranexamic Acid (IV TXA) has been shown to significantly reduce blood loss and transfusion rates after total knee arthroplasty (TKA), without increasing the risk of thromboembolic events. Certain patient populations may not be candidates for IV TXA, including those with a history of thromboembolic disorders such as previous stroke, myocardial infarction, deep vein thrombosis (DVT), or pulmonary embolism (PE).

PURPOSE: To evaluate the efficacy and safety profiles of topical TXA in patients with co-morbid conditions precluding them from IV TXA use.

METHODS: A total of 104 patients were prospectively studied and divided into two groups: 47 in the normal/Low Risk group and 57 in the High Risk group, with the latter representing those with one or more risk factors for thromboembolism, who were not otherwise candidates for IV TXA.

RESULTS: Demographics including age, gender, laterality, and approach (subvastus vs. parapatellar) were similar between groups. There were no statistically significant differences between the groups with regard to postoperative changes in hemoglobin (-3.42g/dL ± 1.07 and -3.68g/dL ± 1.07, p=0.214), total drain output (630.2mL ± 331.6 and 566.9mL ± 343.9, p=0.344) postoperative transfusion rate (2.1% and 3.5%, p=0.675), or total number of complications (3 [6.5%] and 5 [8.8%], p=0.671) for the low and high risk groups, respectively. One patient in the high risk group developed a superficial venous thrombosis of the lower extremity, and there were no other thromboembolic events.

CONCLUSION: Topical TXA appears to exhibit a similar safety and efficacy profile in reducing postoperative blood loss in a group of patients with increased thromboembolic risk, without a significant increase in complications or thromboembolic events. Topical TXA may be an important tool for the orthopedic surgeon to safely decrease blood loss and transfusion among patients who are not otherwise candidates for IV TXA.

Adductor Canal Blocks Provide Superior Pain Control for Primary Knee Arthroplasty: A Randomized Controlled Trial

Abstract ID: Paper 119

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INTRODUCTION: Achieving adequate analgesia while optimizing ambulatory capacity is critical to patient satisfaction after total knee arthroplasty (TKA). Adductor canal blocks (ACB) have been suggested as an alternative to traditional techniques, as this purely sensory block should not cause lower extremity weakness. The purpose of this randomized controlled trial was to compare ACB with a traditional neuraxial anesthetic in terms of postoperative pain control and ambulation.

METHODS: 35 Patients undergoing TKA were randomized to one of three (3) groups: combined spinal-epidural (CSE), spinal+ACB, or general+ACB. An epidural catheter was used for postoperative pain control in the CSE group and an adductor canal catheter was used in the ACB groups. Outcomes evaluated included ambulation distance, DVPRS pain scores, time to discharge, opiate consumption, and patient satisfaction. Statistical analysis was performed using ANOVA.

RESULTS: Four patients were removed for protocol deviations, leaving 12 in CSE, 11 in spinal+ACB and 8 in general+ACB groups. Patient demographics were similar suggesting appropriate randomization ($p>0.05$ all comparisons). There was a trend toward greater ambulation in the ACB groups (142 feet CSE vs. 245 feet spinal+ACB and 204 feet general+ACB, $p=0.28$). Pain scores were consistently lower in the ACB groups compared to CSE, with significantly lower scores on POD 1 ($p=0.0035$) and POD 2 before and after PT ($p=0.0033$, $p=0.0161$). Time to discharge was lower in the spinal+ACB group (63 hours CSE, 40 hours spinal+ACB and 47 hours general+ACB, $p=0.03$). There was a trend toward lower total opiate consumption in the spinal+ACB group (200 morphine equivalents CSE, 109 spinal+ACB and 207 general+ACB, $p=0.12$). More patients reported being “Very Satisfied” in the ACB groups (45% CSE, 91% spinal+ACB, 88% general+ACB, $p=0.018$).

CONCLUSION: The adductor canal block provided superior pain control with significantly faster time to discharge and greater patient satisfaction with a trend towards greater ambulatory ability.

Femoral Nerve Catheter Provides Superior Pain Control Compared to Periarticular Injection of Liposomal Bupivacaine Following Total Knee Arthroplasty: A Review of 462 Cases

Abstract ID: Paper 120

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INTRODUCTION: It is unclear whether local infiltration with liposomal bupivacaine (LB) following total knee arthroplasty (TKA) has similar efficacy on pain control compared to the use of femoral nerve catheter (FNC). Our goal was to compare narcotic consumption, pain-related emergency department (ED) visits and postoperative patient complaint phone-calls related to pain between patients managed with (1) LB, (2) LB with adductor canal block, and (3) FNC.

METHODS: 571 consecutive primary TKA for osteoarthritis performed between 2010-2014 were reviewed. Patients who refused nerve blocks (n=48) or received alternate pain management protocols (n=60) were excluded. Of the remaining 462 cases, n=175 received FNC, n=65 received LB, and n=222 received LB in conjunction with adductor canal blockade. All patients received oral pain medication in the holding area and a single shot spinal 0.75% bupivacaine in the operating room. Postoperatively, oral narcotics were used as needed. Tourniquet time and length of postoperative acute care unit stay were statistically adjusted to account for the length and complexity of each case.

RESULTS: There was a significant difference among the 3 groups in terms of length of stay (LOS) ($p<0.0001$), with patients who received FNC staying in the hospital the longest. Narcotic consumption was also different among the 3 groups at all time points ($p<0.0001$), with patients who received a FNC tolerating a longer period of time before the first narcotic and consuming less narcotics overall. Pain-related ED visits and phone calls were not significantly different between the groups.

DISCUSSION: While FNC patients had longer LOS, this study demonstrates superior pain control compared to local injection with liposomal bupivacaine. The addition of adductor canal blockade to the use of LB did not seem to enhance pain control. Careful patient selection is necessary prior to the use of liposomal bupivacaine as it may be associated with higher opioid consumption.

Assessing Risk Factors for 30-Day Readmission After Total Knee Arthroplasty: A Retrospective Analysis

Abstract ID: Paper 121

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INTRODUCTION: The implementation of the Affordable Care Act has led to the development of several quality care measures regulated by the Center for Medicare and Medicaid Services. Thirty-day readmission rate is one measure used to assess quality and cost. As such, clinicians should become more familiar with risk factors associated with increased postoperative readmissions. A better understanding of patient attributes and comorbidities, as well as their effect on 30-day readmissions, will allow improvement in postoperative outcomes following TKA. The goal of this study is to assess data that may aid in preoperative counseling, and mitigate potential causes of higher readmission. Addressing specific areas that contribute to higher readmissions could alter the financial burden placed on the healthcare system.

METHODS: Data collected from January 2010 to December 2013 of 2,378 patients who underwent primary TKA at a level 1 trauma center was categorized into two groups based on postoperative 30-day readmission status. Group I consisted of 2,277 patients who were not readmitted following surgery. Group II consisted of 101 patients with ≥1 readmission within 30 days. Potential risk factors were assessed including demographics, social determinants, medical comorbidities, surgical indications, and postoperative interventions. Logistic regression using the Firth penalized likelihood was used to determine which variables best predict readmission. Statistical significance was considered with a p-value <0.05.

RESULTS: Data analysis identified several risk factors for 30-day readmission following TKA. The risk of readmission after postoperative transfusion and in patients with cardiovascular disease was statistically significant, with odds ratios (OD) of 2.717 (95% CI) and 1.799 (95% CI), respectively. SF-36 scores with high physical (1.00; 95% CI) and emotional (1.00; 95% CI) components were associated with a lower risk of 30-day readmission. Paradoxically, patients preoperatively diagnosed with anemia were less likely to be readmitted (OD 0.524; 95% CI). Medical and social factors, such as tobacco use, length of stay (LOS), SF-36 mental component score, urinary tract infection, acute and chronic renal insufficiency, pulmonary disease and endocrine pathologies were not at a statistically significant higher risk for readmission in the setting of primary TKA.

CONCLUSION: Thirty-day readmission was significantly increased in patients who received postoperative blood transfusions, patients diagnosed with cardiovascular disease or patients with low SF-36 scores in the emotional and physical components. Notably, preoperative anemia was associated with significantly lower readmission rates. Although, our study identifies 30-day readmission risk factors, further research is needed to determine how to clinically incorporate these results.

Distal Femoral Morphology: Does Ethnicity, Gender, or Body Size Play a Role?

Abstract ID: Paper 122

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INTRODUCTION: In total knee arthroplasty (TKA), the rotational alignment of the femoral component is critical for proper patellofemoral tracking, varus-valgus balancing, and for the avoidance of femoral notching. Limited data exists regarding the influence of patient demographic factors on the femoral anatomic landmarks used to evaluate rotational alignment during TKA. The aim of this study was to evaluate the way in which distal femoral morphology varies based on patient ethnicity, gender, and body size.

PATIENTS AND METHODS: Magnetic resonance imaging (MRI) studies of the knee were retrospectively reviewed for 193 consecutive adult patients. The transepicondylar axis (TEA), posterior condylar axis (PCA), and Whiteside's line (WL) were documented for each patient. The angles formed between the TEA–PCA and the TEA-WL were recorded. Demographic information was gathered from the electronic medical record including age, gender, ethnicity, height, and body mass index (BMI). Statistical analysis was performed using Student's t-test with an alpha level of 0.05 for significance determination.

RESULTS: This study included 127 females and 66 males. 102 patients were African-American, 41 Caucasian, 26 Hispanic, 7 Asian, and 16 patients were listed as 'other'. The mean TEA-PCA angle was 5.0° (SD 1.71, range 0.3-8.9°) and the mean TEA-WL angle was 89.9° (SD 2.71, range 81.1-105.1°). No statistically significant variability was found for the TEA-PCA angle based on patient ethnicity (African American 4.88°, Caucasian 5.12°, Hispanic 5.01°, Asian 5.48°, p=0.75), gender (male 4.81° vs. female 5.12°, p=0.26), height (<168 cm 5.14° vs. >168 cm 4.88°, p=0.31) or BMI (BMI <29.5 5.03° vs. BMI >29.5 5.00°, p=0.91). Likewise, no significant difference was found in the TEA-WL angle between ethnicity (African American 90.3°, Caucasian 89.1°, Hispanic 90.1°, Asian 90.9°, p=0.14), gender (male 89.6° vs. female 90.2°, p=0.15), height (<168 cm 90.1° vs. >168 cm 89.9°, p=0.56), or BMI (BMI <29.5 89.9° vs. BMI >29.5 90.0°, p=0.93).

CONCLUSION: This study demonstrates that the angle between the transepicondylar axis and posterior condylar axis does not vary significantly based on ethnicity, gender, height, or BMI. Likewise, the angle between transepicondylar axis and Whiteside's line did not demonstrate a relationship with these patient demographic factors. Despite no relationships being found for these patient demographic factors, considerable variability remains in the population as a whole and this variability must be taken into account during TKA to ensure satisfactory rotational alignment of the femoral component.

Rotating Platform Total Knee Arthroplasty vs. Fixed Bearing Total Knee Arthroplasty at Mid-Term Follow-Up

Abstract ID: Paper 123

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INTRODUCTION: Rotating platform posterior stabilized (RP) total knee arthroplasty (TKA) was initially developed to decrease polyethylene wear and improve patellar tracking. There have been limited long-term studies comparing postoperative complications and reoperation rates between fixed bearing posterior stabilized (FB) and RP TKAs. The following study is the largest cohort of patients that we are aware with RP TKAs to date and describes the causes of reoperation and long-term survival rates.

METHODS: Utilizing the total joint registry at our institution, we identified 11,416 patients who underwent a primary posterior stabilized between 2001 and 2013. This group was separated into RP (n=926) and FB (n=10,490) TKA designs. Patient demographics and preoperative diagnoses were analyzed by implant type. Kaplan-Meier survival rates for each complication that led to reoperation were determined at 5- and 10-years postoperatively. Univariate hazard ratios were determined for the most common causes for reoperation as well as overall implant survival rates. Finally, a multivariate analysis was performed to account for the differences in age, gender, and preoperative diagnosis between groups.

RESULTS: Patient demographic data between the RP and FB TKA designs were statistically different in regards to age, gender, and preoperative diagnosis, but not BMI. We noted a significant increase in all cause reoperation rate ($p=<0.001$) and reoperation rate for stiffness in the RP group ($p=0.001$). However, after accounting for the demographic variances, there were no significant differences in reoperation rate or reoperation for stiffness. The RP group was found to have increased survival free of all-cause revision and revision for aseptic loosening or osteolysis ($p=0.029$). There was also a trend towards decreased periprosthetic fracture risk in the RP group, but this did not reach statistical significance.

CONCLUSION: Prior to adjusting for patient preoperative demographic data, we noted the rotating platform group had a significantly increased all cause reoperation and reoperation for stiffness. The majority of these were manipulations under anesthesia. This difference was not statistically significant after patient demographics were adjusted for statistically. Importantly, we did observe a significant decrease in the all-cause revision rate and the revision rate for aseptic loosening/osteolysis at 10 years postoperatively.

Total Knee Arthroplasty in the Younger Patient: National Trends and In-Hospital Outcomes

Abstract ID: Paper 124

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INTRODUCTION: Recent literature has shown that patients younger than 50 years of age have an increased risk of revision surgery due to aseptic mechanical failure and periprosthetic infection one year after primary total knee arthroplasty (TKA). The purpose of this study was to compare patient demographics, in-hospital outcomes, and national trends for primary TKA between young and senior patients.

METHODS: The National Hospital Discharge Survey database was searched using ICD-9 codes for patients admitted to U.S. hospitals for unilateral primary TKA during the years 2001-2010. Patients were separated into a young cohort (≤50 years) and a senior cohort (≥65 years). ICD-9 codes were used to identify demographics, in-hospital adverse events, and discharge disposition. Statistical analysis included linear regression with Pearson's correlation coefficient (r), Student's t-test, and chi-square analysis with a significance level of 0.05.

RESULTS: 2,130 primary TKA patients ≤50 years (young cohort, mean 45.8 years) and 19,660 ≥65 years (senior cohort, mean 73.8 years) were identified. In the young cohort, the percentage of TKAs performed per year remained stable at between 5.7% and 7.2% (r=0.05) throughout the study period. Alternatively, the senior cohort demonstrated a strong negative correlation with time (r=-0.93) decreasing from 64.7% in 2001 to 55.2% in 2010.

The young cohort had a significantly higher percentage of males (39.3% vs. 34.2%, $p<0.01$), greater rate of obesity (17.3% vs. 7.8%, $p<0.01$), and morbid obesity (6.0% vs. 1.9%, $p<0.01$) compared to the senior cohort. The young cohort had a shorter average hospitalization (3.5 vs. 3.8 days, $p<0.01$), was less likely to be discharged to rehab (11.7% vs. 34.0%, $p<0.01$), had fewer medical co-morbidities (4.2 vs. 5.2, $p<0.01$), experienced a lower rate of pulmonary embolism (0.09% vs. 0.49%, $p=0.056$), and was less likely to receive a blood transfusion (9.9% vs. 19.8%, $p<0.01$) compared to the senior cohort. No significant differences were found in the rates of deep vein thrombosis ($p=0.848$), postoperative wound infection ($p=0.432$), or mortality ($p=0.332$).

CONCLUSIONS: This study demonstrates that patients ≤50 years of age undergoing a TKA have more than double the rate of obesity and triple the rate of morbid obesity when compared to patients ≥65 years of age. Despite this, younger patients have a more favorable discharge disposition and a lower risk of in-hospital adverse events. The high rate of obesity seen among young patients undergoing TKA may explain the higher rates of periprosthetic infection and aseptic mechanical failure seen in this patient population.

Comorbidities and Discharge Disposition in Total Joint Arthroplasty Patients

Abstract ID: Paper 125

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BACKGROUND: Total joint arthroplasties are predictable and highly successful procedures. While economically beneficial to society, the procedures are associated with high costs. Readmissions to hospitals during the global period clearly drive up the cost of the episode of care. With Medicare patients, readmissions are linked to hospital “clawbacks” and have significant economic consequences. Using prospectively collected and specifically abstracted data from a total joint database, our patient demographic factors were examined as they relate to readmission.

METHODS: Hospital data that were specifically abstracted for a statewide quality collaborative (Michigan Arthroplasty Registry Collaborative Quality Initiative) were examined. We evaluated: body mass index, gender, diabetes, smoking, history of deep vein thrombosis/pulmonary embolism (DVT/PE), and discharge disposition (discharged home vs. external care facility) of the 30-day readmission profile using univariate analysis. There was a cohort of 2914 patients entered into the database between 2012-2014.

RESULTS: Patients discharged to an external care facility had a higher frequency of diabetes (17.6% vs. 24.8%, $p=0.0012$), DVT/PE (19.8% vs. 34.4%, $p<.0001$), and were more likely to be female (14.9% vs. 23.6%, $p<.0001$). There was no significant difference between any comorbidity and readmission rate. However, patients who were discharged to an external care facility had a higher readmission rate (2.9% vs. 7.2%, $p<0.0001$).

CONCLUSIONS: Patients with diabetes, history of DVT/PE, or female gender showed higher frequencies of discharge to external care facilities. Since patients discharged to these facilities had a higher rate of readmission, these factors should be taken into account moving forward for risk stratification as it relates to cost of care.

MAOA BREAKOUT SESSION #10
HIP PRESERVATION AND ARTHROSCOPY
April 15, 2016

Does Age Matter? Comparing Outcomes of Hip Arthroscopy in Patients Younger and Older Than 55

Abstract ID: Paper 126

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PURPOSE: Hip arthroscopy can be an effective, less invasive treatment for hip pathology when compared to open hip arthrotomy. While appealing in younger patients, the efficacy of hip arthroscopy in older patients is not as clearly identified. There is little information in the literature that directly compares outcomes of hip arthroscopy in different age groups. The purpose of this study was to (1) evaluate clinical outcome scores of patients undergoing hip arthroscopy and (2) compare the outcomes in patients older or younger than 55 years of age.

METHODS: Between 1996 and 2013, a total of 201 (63M:138F) patients undergoing primary hip arthroscopy with a potential 2 years of follow-up were isolated from a prospectively created database. 174 patients were under age 55 (mean age 36.6), whereas 27 were 55 or older (mean age 61.3). Mean preoperative Tonnis grades between the younger and older groups were similar (1.11 vs. 1.3, p=.09). Patients were evaluated at baseline, 1 year, 2 years, and 5 years postoperatively using Modified Harris Hip Scores, Hip Outcome Scores (ADL and Sport subsets) and IHOT. A Wilcoxon signed rank sum test for continuous and ordinal variables was used to evaluate the differences between the cohorts in outcome scores both preoperatively and each interval postoperatively.

RESULTS: Each cohort had statistically similar outcome scores preoperatively, and at 1 year postoperatively. At 2 years, scores were similar between groups for MHHS, and IHOT; however, patients younger than 55 had significant improvements over patients older than 55 in Hip Outcome Scores subgroups for ADL score (85.6 vs. 75.2 p=.03) (figure 1), ADL Rating (80.1 vs. 70.0 p=.004) (figure 2), Sport Score (70.2 vs. 55.6 p=.04) (figure 3), and Sport Rating (70.2 vs. 58.0 p=.04) (figure 4). At 5 years, patients older than 55 reported better outcomes for Function Rating (p=.04); all other outcomes were similar.

CONCLUSION: In this age-stratified comparative study of patients undergoing arthroscopic labral repair, younger patients had superior hip outcomes at short-term follow-up, but these advantages did not appear to persist with longer follow-up. Our data suggests that carefully selected patients older than 55 years of age can have comparative mid-term results following labral repair compared to younger patients.

Click here to view Figure 1

Click here to view Figure 2

Click here to view Figure 3

Click here to view Figure 4

Ligamentum Teres Tear and Debridement as a Positive Predictor for the Recovery of Hip Arthroscopy in Female Patients

Abstract ID: Paper 127

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INTRODUCTION: Hip arthroscopy classically has good to excellent outcome in correctly identified populations. Positive predictors in other studies have been acute onset of symptoms, labral tear, and non-arthritic status. This study looks at another positive predictor.

BACKGROUND: We compared the clinical and statistical outcomes of female patients undergoing arthroscopic hip surgery. 31 females underwent standard hip arthroscopy during the months of December 2012 to January 2014, 18 subjects showing no ligamentum teres tear pathology with 13 having a tear, all of which went to 1 year postoperative status with 14 at 2 years postoperative as of now; 5 with ligamentum teres tears and 9 without.

PURPOSE: The literature available on Ligamentum Teres Pathology and recovery is sparse so the purpose of this study is to determine whether females showing ligamentum teres pathology show better recovery over a 1 (or 2) year period to prove the practicality in repairing.

METHODS: 31 females underwent standard hip arthroscopy with prospectively gathered VAS and mHHS data over a 2-year postoperative status. VAS and mHHS data points were recorded preoperatively and at several postoperative checkpoints. This data was then evaluated retrospectively and subjects were stratified into groups based on the ligamentum teres pathology. Significance of data was determined using an ANOVA test.

RESULTS: There are five data points that show significance when comparing female patients with and without ligamentum teres tears: VAS at 2 weeks, 3 months, and 2 years postop and mHHS at 3 and 6 months postop. At 2 weeks postop, patients with vs. without ligamentum teres tears had a mean VAS of 2.063 +/- 2.190 and 4.018 +/- 2.065, respectively (p-value = 0.017). At 3 months postop, patients with vs. without had scores of 0.646 +/- 0.895 and 2.554 +/- 2.399 respectively (p-value = 0.023). At 2 months with versus without scores were 0.694 +/- 0.962 and 3.504 +/- 2.566, respectively (p-value = 0.038). At 3 months postop, with versus without had an mHHS of 82.231 +/- 7.801 and 70.389 +/- 14.967, respectively (p-value of 0.014). At 6 months postop, with versus without had scores of 82.846 +/- 6.986 and 73.333 +/- 11.99 respectively (p-value = .035).

DISCUSSION: 5 sets of data points show significance: VAS at 2 weeks, 3 months, and 2 years postop and mHHS at 3 and 6 months postop. This study shows that patients with ligamentum teres tears may have more predictable outcomes than those without.

The Influence of Acetabular Labral Width on Outcomes After Hip Arthroscopy: A Matched Cohort Study

Abstract ID: Paper 128

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INTRODUCTION: Recent research has improved our biomechanical understanding of the acetabular labrum. However, the effect of certain intrinsic parameters, including labral width, on outcomes of treatment are still unclear. This study investigated relationships between acetabular labral width and outcomes at minimum two years after hip arthroscopy.

METHODS: From February 2010 to August 2012, data were prospectively collected on all patients undergoing hip arthroscopy. Anatomic characteristics were measured intraoperatively. Patients were assessed pre- and postoperatively with four patient-reported outcome (PRO) measures: modified Harris Hip Score (mHHS), Non-Arthritic Hip Score (NAHS), Hip Outcome Score-Activities of Daily Living (HOS-ADL), and Hip Outcome Score-Sport Specific Subscales (HOS-SSS). Pain was estimated on the visual analog scale (VAS). Patient satisfaction was measured on a scale from 0 to 10.

RESULTS: The mean labral width was 4.6 mm. Patients with labral width less than 4.6 mm were younger, had smaller labral tears and acetabular chondral lesions in terms of clock face, had lower grades of acetabular chondral damage in terms of acetabular labral articular disruption (ALAD) and Outerbridge classifications, and were less often treated with labral debridement ($p<0.05$). Patients in both groups showed significant improvements in all PRO scores at minimum two-year follow-up (p0.05). After matching, patients in both groups showed significant improvements in all PRO scores at minimum two-year follow-up ($p<0.0001$), but no significant differences in PRO scores were observed between groups ($p>0.05$).

CONCLUSIONS: When considered independently from other factors, labral width is not a useful prognostic factor in determining patient outcomes following hip arthroscopy. However, smaller width of the labrum may be related to better outcomes at short-term follow-up via other patient characteristics, such as younger age and less damage to the labrum and acetabular cartilage.

Complications Following Periacetabular Osteotomy Alone vs. In Combination With Hip Arthroscopy: A Multicenter Study

Abstract ID: Paper 129

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BACKGROUND: Hip arthroscopy has come into favor as a means to visualize intra-articular pathology prior to proceeding with periacetabular osteotomy (PAO) in order to treat intra-articular pathology or determine whether patients are candidates for undergoing PAO. The advantages include direct visualization of the joint space and decreased requirement for an open arthrotomy during PAO to assess the labrum or cartilage. Although the addition of hip arthroscopy adds to operative time and leads to increased fluid extravasation into the soft tissues, it is unclear if it affects the rate of postoperative complications. The purpose of this study was to determine whether hip arthroscopy prior to PAO causes an increased risk of complications compared to PAO alone.

METHODS: A multicenter prospective hip preservation database was reviewed to select patients who underwent hip arthroscopy for treatment of chondrolabral pathology immediately prior to PAO between 2007–present. Charts were reviewed retrospectively to identify the incidence of postoperative complications, need for additional treatment, and repeat surgical intervention. The modified Dindo-Clavien classification system was used to stratify complications.

RESULTS: 185 hips (176 patients) underwent combined hip arthroscopy and PAO, including 150 females (81%) and 17 males (13%) with a mean age of 27.6 years. Median duration of surgery was 209 minutes, with a median estimated blood loss of 595 mL. Labral repair was performed in 111 hips (60%), while labral debridement was performed in 11 additional hips (6%). Acetabular chondroplasty was performed in 83 hips (45%). Grade 3 complications occurred in 2.7% of patients (n=5), while no Grade 4 complications occurred. Grade 3 complications included deep infection (n=2), hematoma requiring exploration (n=1), symptomatic heterotopic ossification requiring excision (n=1), and deep venous thrombosis (n=1).

DISCUSSION AND CONCLUSION: Compared to previously published complication data on PAO alone that reported incidence of complications as 5.9%, we found a 2.7% incidence of complications in patients who underwent hip arthroscopy prior to PAO. Although hip arthroscopy increases operative time, it was not observed to increase the risk of complications following hip preservation surgery. Additional studies may be warranted to evaluate this study question in a randomized controlled fashion.

Twenty-Eight Year Hip Survivorship and Outcomes of Patients Treated With a Periacetabular Osteotomy for Acetabular Dysplasia

Abstract ID: Paper 130

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INTRODUCTION: The aims of the study were to (1) determine the clinical outcome after Ganz periacetabular osteotomy (PAO), and (2) determine the survivorship of the hip joint after a Ganz PAO.

METHODS: A Ganz PAO was performed on 415 hips by a single surgeon over a 28-year period. The current study is a retrospective study and is on-going. Follow-up data was obtained from 231 hips. Clinical outcomes were assessed by the Hip disability and Osteoarthritis Score (HOOS) and UCLA activity scores. Clinical outcomes were assessed for patient cohorts 1-5, 5-10, 10-15, 15-20, and greater than 20 years post-PAO. Survivorship of the hip was determined with total hip arthroplasty as the endpoint.

RESULTS: Of the 231 hips analyzed, 40 hips (38 patients) underwent a total hip arthroplasty with an average survivorship of 9.8 years (min 0, max 22 years). Of the existing post-PAO hips who did not convert to a THA, the longest survivorship is approximately 28 years. HOOS and UCLA activity scores for the non-converted group were 82.3, 82.1, 76.6, 80.2, and 80 for patients 0-5, 5-10, 10-15, 15-20, and 20+ years post-PAO, respectively. UCLA activity scores were 8.0, 7.0, 6.7, 6.7, and 6.3 for patients 0-5, 5-10, 10-15, 15-20, and 20+ years post-PAO, respectively. The distribution survivorship percentage of hips that converted to a THA after PAO is as follows: 30%, 22%, 37.5%, 7.5%, and 2.5% after 0-5, 6-10,11-15,16-20, 20+ years post-PAO, respectively. Of the patients who underwent a THA, the average age at the time of their PAO was 34.5 years.

CONCLUSIONS: Ganz periacetabular osteotomy for acetabular dysplasia has been utilized to preserve the native hip joint and prevent the need for a total hip arthroplasty. The average survivorship after PAO by the senior author is 9.8 years. Forty of 231 hips analyzed converted to a THA (17.3%). Of the surviving hips, the functional outcome scores did not significantly decline. Approximately 50% of hips that will convert to a THA will do so within 10 years post-PAO. This on-going study represents the largest single-surgeon cohort study of patients followed over 28 years after Ganz periacetabular osteotomy.

Acetabular Chondral Lesions in Hip Arthroscopy: Relationships Between Grade, Topography, and Demographics

Abstract ID: Paper 131

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BACKGROUND: Human acetabular cartilage covers the central and inferior regions of the acetabulum. Multiple factors, including traumatic injury, metabolic damage, and morphologic variations such as femoroacetabular impingement (FAI), can damage the articular cartilage and contribute to progression of osteoarthritis. However, quantitative relationships between patient characteristics, extent of chondral damage, and topology of chondral lesions have not been established.

PURPOSE: To compare the extent of acetabular chondral damage, measured in terms of acetabular labrum articular disruption (ALAD) and acetabular Outerbridge grades, to the size and position of the chondral lesions, as well as patient demographic factors.

METHODS: This study included all hip arthroscopies performed by the corresponding author from August 7, 2008, and November 19, 2014, in which acetabular chondral lesions were intraoperatively identified and measured in terms of acetabular labrum articular disruption (ALAD) and acetabular Outerbridge grades, clock face position, and size. Demographic factors assessed included gender, age, height, weight, and BMI. Significant differences between patients with different grades of chondral damage were detected using ANOVA and the Tukey-Kramer post-hoc test for continuous variables and the $_{\chi}2$ test for categorical variables. P-values less than 0.05 were considered significant.

RESULTS: Acetabular chondral lesions were intraoperatively identified in 1,537 patients during the study period. Patients with shorter stature, lower weight, and lower BMI tended to have lower grades of damage, as measured by the ALAD and Outerbridge classifications. Patients with higher grades of damage were older and more often male. Higher ALAD and Outerbridge grades were associated with larger chondral lesions. Lesions were generally centered in the anterosuperior region of the acetabulum, regardless of the grade of damage.

CONCLUSION: Higher grades of acetabular chondral damage were related to male sex, increased age, height, weight, BMI, and the size of the lesion. Chondral lesions were generally found in the anterosuperior region of the acetabulum, consistent with labral lesions and the weight-bearing area of the acetabulum.

Natural History of Hip Impingement and Dysplasia Over 10-35 Years in Patients Without Initial Degenerative Changes

Abstract ID: Paper 132

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INTRODUCTION: Structural hip deformities including congenital hip dysplasia (CHD) and femoroacetabular impingement (FAI) are thought to predispose patients to degenerative joint changes. However, the natural history of these malformations is not clearly delineated. The purpose of this investigation was to compare the long-term natural history of CHD and FAI to patients without structural deformity and identify radiographic parameters that may be predictive of prognosis.

METHODS: We retrospectively reviewed our institutional total joint registry to identify patients ≤55 years that received unilateral primary total hip arthroplasty (THA) from 1980-1990. Preoperative radiographs were reviewed on the contralateral non-operative hip with the following inclusion criteria: Tonnis Grade 0 degenerative change; diagnosis of “CHD”, “FAI”, or “normal” morphology; and minimum 10-year radiographic follow-up. Radiographic metrics in conjunction with the review of two experienced arthroplasty surgeons determined structural hip diagnosis. Every available follow-up AP radiograph was reviewed to determine progression from Tonnis Grade 0–3 until the time of last follow-up or operative intervention with THA. Survivorship was analyzed by Kaplan-Meier methodology.

RESULTS: 162 patients met all eligibility criteria with the following structural diagnoses: 48 CHD, 74 FAI, and 40 normal. Mean age at the time of study inclusion was 47 (range 18-55), with 56% females. Mean follow-up was 20 years (range 10–35 years). 35 patients eventually required THA (16 CHD, 13 FAI, 6 normal; p=0.0757). Median survival for progression from Tonnis Grade 0–1, 0–2, and 0–3 and/or THA was as follows: CHD = 15.9 years, 27.2 years, 33.1 years; FAI = 12.6 years, 25.7 years, 29.9 years; normal = 17.9 years, 30.6 years, 33.6 years (p=0.0669). Amongst all analyzed radiographic parameters, acetabular depth-to-width index ≤0.38, femoral head extrusion index >0.25, and femoral head lateralization ≥10 millimeters increased rate of Tonnis Grade progression (p=0.0127, p=0.0038, p=0.0295, respectively). Age and sex did not change rate of progression.

CONCLUSION: This study defines the long-term natural history of CHD and FAI in comparison to structurally normal young hips with a presumably similar initial prognostic risk (Tonnis Grade 0 degenerative change and contralateral primary THA). Faster rates of degenerative change were observed in CHD and FAI patients; however, differences only trended toward significance, suggesting a similar natural history between structurally normal and diseased hips in many cases. However, radiographic parameters were identified that predicted more rapid degenerative changes. This provides valuable information for surgeons in counseling patients about prognosis with structural hip deformity.

Is MRI Subchondral Acetabular Edema or Cystic Change a Contraindication for Hip Arthroscopy in Patients With FAI?

Abstract ID: Paper 133

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BACKGROUND: The outcome for arthroscopic treatment of femoroacetabular impingement (FAI) can worsen with increasing arthritis. However, there remains a subset of hips with maintained radiographic joint space but with MRI acetabular subchondral edema and cystic change with unknown outcome.

PURPOSE: (1) To correlate MRI findings of subchondral acetabular edema/cystic change with arthroscopy grading of articular cartilage and (2) to determine if postoperative outcome was worse for patients with subchondral edema compared to a matched control group with similar age and activity level.

METHODS: The records of all patients who underwent arthroscopic hip surgery for FAI between 2007 and 2013 were reviewed for subchondral edema/cyst on preoperative MRI. Lesions were characterized by grade using an established classification system and correlated to arthroscopic articular cartilage changes. A matched cohort of similar age and activity level patients with same Tonnis grade on preoperative x-rays and without evidence of subchondral edema or cyst was identified. Minimum two-year postoperative outcome was compared using prospectively collected Hip Outcome Score (HOS) and Modified Harris Hip Score (HHS). Overall success was defined as hip activity level rating of normal or nearly normal on the HOS. Failure was defined as the combination of conversion to hip replacement or a rating of abnormal or severely abnormal.

RESULTS: Overall, 102 patients are included. Thirty-four patients (17 males, 17 females) with average age of 41 years (19-67) had subchondral edema with mean 30 month follow-up (24-60 months). Sixty-eight patients (18 males, 50 females) with an average age of 41 years (range 18-69) were included in the control group. Overall, the presence of subchondral edema/cystic changes was indicative of advanced articular cartilage degeneration, with 31 of 34 patients (91%) demonstrating grade IV articular cartilage loss of the acetabulum at the time of arthroscopy. In addition, 100% of patients with subchondral cystic change greater than 5 mm had evidence of a grade IV full thickness cartilage lesion at the time of hip arthroscopy (13 patients). Average HHS were inferior for the subchondral edema group (76.9 ± 19.4 vs. 86.6 ± 14.1; P = 0.006). HOS also showed lower scores for the subchondral edema group (ADL 81.1 ± 19.7 vs. 88.8 ± 12.7, P = 0.02; Sport 65.5 ± 25.9 vs. 79.8 ± 50.5, P = 0.004). Overall success rate was 68% in the subchondral edema group compared to 85% in the control group (P = 0.04).

CONCLUSIONS: The presence of a subchondral acetabular cyst on MRI is indicative of a full thickness cartilage lesion at the time of arthroscopy. These patients have inferior outcomes for

arthroscopic treatment of FAI compared to patients with similar age and activity level without MRI subchondral changes.

Predictive Value of Preoperative Anesthetic Hip Joint Injections for Determining Clinical Outcomes After Hip Arthroscopy

Abstract ID: Paper 134

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INTRODUCTION: Selection of patients for hip arthroscopy is based on their history and clinical findings, and a radiographic evaluation that includes MR imaging. Anesthetic hip joint injections also are performed because they have a reported accuracy of 90% for identifying patients with intra-articular pathology, and pain relief with preoperative anesthetic injections has been linked to good arthroplasty outcomes. These results have led to the conclusion that there is a direct relationship between the response to preoperative anesthetic injections and the results of hip arthroscopy when such a relationship has not been established. The purpose of this study was to assess the predictive value of preoperative anesthetic hip joint injections for determining the clinical outcomes of hip arthroscopy.

METHODS AND MATERIALS: From a review of our MRI and hip arthroscopy data bases, we identified 93 patients that had: (1) a preoperative MRA and anesthetic hip joint injection at our institution; (2) a subsequent hip arthroscopy performed by the senior author; and (3) MRA images, operative reports, pre- and post-anesthetic injection pain scores, and one-year modified Harris Hip Scores (MHHS) available for review. Two musculoskeletal radiologists reviewed the MRA images, and by consensus, catalogued the type and size of labral tears, and the degree of degenerative joint disease (DJD) present. Hip post-injection pain relief was recorded as Good (>60% relief), Moderate (31-60% relief), or Poor (0-30% improvement), and these results were compared to the one-year arthroscopy outcomes which were based on the MHHS and rated as Good (>79 points), Fair (70-79 points), or Poor (<70 points). Secondary analyses of the predictive effect of age, gender, body mass index (BMI), type and size of labral tear, and DJD were performed by univariate (Fishers exact) and multivariate (ANOVA) methods.

RESULTS: There was no significant correlation (p=0.59) between anesthetic injection responses (pain relief) and one-year MHHS (surgical outcomes). Univariate and multivariate analyses of arthroscopic outcomes and: (1) patient age (p=0.31) and gender (p=0.83); (2) degree of DJD (p=0.26); and (3) type and size of labral tear type (p=0.34) also demonstrated no significant correlations. BMI was the only variable that demonstrated significant correlation to surgical outcome (p=0.03); patients with BMI ≥25 kg/m^2 had a much lower percentage (45% vs. 71%) of good surgical outcomes.

CONCLUSIONS: Preoperative anesthetic hip joint injections had no predictive value for determining the one-year outcomes of hip arthroscopy patients. Thus, a patient's response to an anesthetic hip joint injection should not be the sole variable by which to determine hip arthroscopy candidacy.

Preoperative MRI as a Prognostic Factor for Outcomes of Core Decompression for Osteonecrosis of the Femoral Head

Abstract ID: Paper 135

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INTRODUCTION: Osteonecrosis of the femoral head (ONFH) is a potentially debilitating condition that can lead to a need for total hip arthroplasty (THA). Due to the high rate of failure after non-operative treatment, hip core decompression has become a common pre-collapse surgical technique. However, failures are common and literature to guide the surgeon to appropriately select a patient for hip core decompression is limited. The aim of this study was to examine how preoperative MRI findings correlate with outcomes of a modified core decompression technique.

METHODS: Inclusion criteria are patients with a preoperative MRI, Steinberg stage I or II osteonecrosis, and greater than 1 year of documented follow-up. All preoperative MRIs were interpreted by a musculoskeletal-trained radiologist. Patients were stratified according to percent involvement of the femoral head (0-15%, 15-30%, >30%) and hip effusion grade (0-3). The lead surgeon performed core decompression with a modified technique on all patients. Standard operative and postoperative protocols were used. Failure of procedure is defined as the patient needing a total hip arthroplasty. Fisher's exact test and multivariate logistic regression were used for statistical analysis with p-values <0.05 considered significant.

RESULTS: One hundred patients were included with an average follow-up of 40 months (12 to 97 months). Forty-two of 100 (42%) underwent THA. Increased grade of effusion was an independent risk factor for THA (OR=2.30, 95% CI [1.27-4.18], p=0.006). THA was ultimately necessary in 1/13 (8%) patients with grade 0 effusion, 17/42 (42%) grade 1, 12/35 (34%) grade 2, and 12/12 (100%) grade 3. Percent involvement of the femoral head was also an independent risk factor for THA (OR=4.66, 95% CI [2.07-10.52], $p<0.001$). THA was performed in 0/17 (0%) of patients with 0-15% head involvement, 10/32 (31%) with 15-30% head involvement, and 32/51 (63%) with >30% head involvement. There were no failures in patients (0/10) with grade 1 or less effusion and <15% femoral head involvement, $p<0.001$. Patients with grade 2 or higher effusion and >30% femoral head involvement underwent THA in 20/29 (69.0%) patients, $p<0.001$.

DISCUSSION AND CONCLUSION: Grade of hip effusion and percent involvement of the femoral head are prognostic indicators of success/failure of core decompression for ONFH. Patients with minimal hip effusion and/or minimal involvement of diseased femoral head should be counseled to undergo a less invasive procedure like core decompression. Conversely, patients with a large hip effusion or significant amount of diseased femoral head may be better served with total hip arthroplasty.

Does Previous Hip Arthroscopy Impact the Clinical Outcomes of Total Hip Arthroplasty?

Abstract ID: Paper 136

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INTRODUCTION: Hip arthroscopy is a well-accepted intervention for the treatment hip disorders such as labral tears, as well as structural pathology; predominantly femoroacetabular impingement (FAI). In spite of arthroscopic intervention, osteoarthritis can develop and progress to eventually require total hip arthroplasty (THA). The incidence of THA for osteoarthritis following arthroscopy has been reported to be as high as 16%. The primary objective of this study was to compare the clinical outcomes of primary THA in patients with and without prior ipsilateral arthroscopic hip surgery.

METHODS: Using our institution's arthroplasty registry, all patients undergoing primary THA following prior ipsilateral hip arthroscopy from December 2000 to September 2013 were identified. Patients were excluded for prior ipsilateral hip fracture or trauma, hip disease secondary to infectious or rheumatologic conditions, or history of any prior ipsilateral hip surgery in addition to arthroscopy. To generate a control group, the study group subjects were matched in a 1:2 manner with patients from the same arthroplasty registry who had no ipsilateral hip surgery prior to primary THA. Preoperative and 1 year postoperative outcomes measures, including the Modified Harris Hip Score (mHHS), UCLA Activity Score, and WOMAC Pain, Stiffness and Physical Function Score, were obtained. All complications were recorded for each group.

RESULTS: Seventy-two patients who had an ipsilateral arthroscopic hip surgery prior to primary THA were identified. Mean follow-up was 3.2 years (range 1-10) following primary THA. The average time between arthroscopic hip surgery and primary THA was 28 months (range 1-102 months). There were no significant differences between the preoperative, postoperative, and improvements in the mHHS, UCLA activity measure, and WOMAC subscores. In the study group, two patients experienced hip dislocation, managed by closed reduction and abduction bracing. One patient in the control group had a deep infection of the THA requiring explant with antibiotic spacer placement, antibiotic therapy, and staged replantation.

CONCLUSIONS: Our results show that at mid-term follow-up, prior arthroscopic hip surgery did not negatively impact the clinical outcome of a patient undergoing subsequent THA. The outcome scores, as well as the absolute increase in the scores seen postoperatively, were similar between groups. There were two major complications in the study group, and one in the control group; however, our study wasn't powered to detect significant differences in complication rate between groups. This study illustrates that prior ipsilateral arthroscopic hip surgery does not adversely affect the clinical outcome of primary THA.

Outcomes of Endoscopic Gluteus Medius Repair in 34 Patients With Minimum Two-Year Follow-Up

Abstract ID: Paper 137

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BACKGROUND: Surgical intervention for gluteus medius (GM) tears is often recommended for patients who have persistent pain despite non-operative treatment. Traditionally, this has been achieved through open techniques with good results; however, advantages of endoscopic techniques include less tissue dissection and improved tendon mobilization. Studies documenting results of endoscopic techniques are minimal and consist of small series with limited follow-up. The study purpose is to provide an update on a previously published study of patients with a GM tear, including a larger cohort and minimum two-year follow-up.

METHODS: Thirty-four patients were identified from April 2009 to April 2012 who had undergone an endoscopic GM repair with minimum two-year follow-up. Patients were excluded if they had revision surgeries and previous hip conditions. Patient reported outcome (PRO) measures collected included the modified Harris Hip Score, Non-Arthritic Hip Score, Hip Outcome Score Activities of Daily Living, and Hip Outcome Score Sports Specific Subscales. The visual analog scale (VAS) and patient satisfaction were also recorded.

RESULTS: The cohort consisted of 2 men and 32 women with a mean age of 57 years (range 20 years to 79 years). Ten patients had a full thickness tear and 24 patients had a partial thickness tear. Seventeen patients were treated with completion of the tear and suture bridge technique and 17 patients with the transtendinous technique. There was a significant improvement of all four PRO at three specified timepoints. The mean pain VAS decreased from 6.6 to 2.4 at two-year follow-up ($p<0.05$). The mean satisfaction was 8.5 at two-years post-surgery. Twenty-six of 34 (76%) patients increased their abduction strength by at least one grade on manual muscle testing. Of 26 patients who had a gait deviation preoperatively, 15 (58%) regained a completely normal gait. There was no significant difference in PRO measures between patients when comparing surgical techniques.

CONCLUSION: Endoscopic surgical repair can be an effective treatment of GM tears at a minimum follow-up of two years.

Clinical Outcomes of Hip Arthroscopy: A Prospective Survival Analysis of Primary and Revision Surgeries

Abstract ID: Paper 138

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BACKGROUND: Recent hip arthroscopy literature has focused on revision hip arthroscopies and conversion to total hip arthroplasty (THA) or hip resurfacing (HR).

PURPOSE: The primary purpose was to perform a survival analysis in a large mixed cohort of patients undergoing hip arthroscopy at a high volume tertiary referral center for hip preservation with minimum two-year follow-up. The secondary purpose was to compare clinical outcomes of primary vs. revision hip arthroscopy.

METHODS: From February 2008 to June 2012, data were prospectively collected on all patients undergoing primary or revision hip arthroscopy. Patients were assessed pre- and postoperatively with modified Harris Hip Score (mHHS), Non-Arthritic Hip Score (NAHS), Hip Outcome Score-Activities of Daily Living (HOS-ADL), and Hip Outcome Score-Sport Specific Subscales (HOS-SSS). Pain was estimated on the visual analog scale (VAS). Patient satisfaction was measured on a scale from 0 to 10.

RESULTS: There were a total of 1155 arthroscopies performed, including 1040 primary arthroscopies (926 patients) and 115 revision arthroscopies (106 patients). Of these, 931 primary arthroscopies (89.5%) in 824 patients (89.0%) and 107 revision arthroscopies (93.0%) in 97 patients (91.5%), were available for follow-up and included in our study. The mean change in patient reported outcome (PRO) scores at two-year follow-up in the primary subgroup was 17.4 for mHHS, 19.7 for HOS-ADL, 23.8 for HOS-SSS, 21.3 for NAHS, and -3.0 for VAS. The mean change in PRO scores at two-year follow-up in the revision subgroup was 13.4, 10.9, 16.1, 15.4, and -2.7, respectively. All scores improved significantly compared to preoperatively ($p<0.001$). PRO scores were higher at all time points for the primary subgroup compared to the revision subgroup ($p<0.05$). Satisfaction was 7.7 and 7.2 for primary and revision subgroups, respectively. Of 931 primary arthroscopies, 52 (5.6%) underwent THA/HR. Of 107 revision arthroscopies, 12 (11.2%) underwent THA/HR. The relative risk of a THA/HR was 2.0 after revision procedures compared to primary procedures. The overall complication rate was 5.3%.

CONCLUSIONS: Hip arthroscopy showed significant improvement in all PRO, VAS, and satisfaction scores at two years postoperatively. Primary arthroscopy patients showed greater PRO scores and a trend towards greater VAS compared to the revision subgroup. The relative risk of a THA/HR was 2.0 after revision procedures compared to primary procedures.

MAOA BREAKOUT SESSION #11
HIP ARTHROPLASTY
April 16, 2016

The Interaction of Obesity and Metabolic Syndrome in Determining Risk of Complication Following Total Joint Arthroplasty

Abstract ID: Paper 139

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INTRODUCTION: The American arthroplasty population is increasingly co-morbid and current quality improvement initiatives demand accurate risk stratification. This investigation assesses risk of complication following THA and TKA attributable to obesity and metabolic syndrome (MetS) as well as seeks to identify any interaction between the two variables.

METHODS: A retrospective analysis of all Medicare patients undergoing elective, primary THA or TKA in a single institution between 2009 and 2013 investigated the interaction between obesity (BMI > 30), MetS, and risk for any Centers for Medicare & Medicaid Services (CMS) reportable complication. MetS was defined as ≥ 2 of the following irrespective of BMI: diabetes, hypertension, dyslipidemia, or sleep apnea. Patient demographics, medical comorbidities, and outcomes were obtained via chart review. Outcomes included CMS-reportable complications (pneumonia, myocardial infarction, death, pulmonary embolism, surgical site infection, surgical site bleeding, catheter-associated urinary track infection, mechanical complication, and readmission), as well as discharge disposition other than home, and length of hospital stay (LOS). Logistic regression models were fit to assess the effect of obesity and MetS on CMS-reportable complications and discharge to other than home; negative binomial regression was used for LOS.

RESULTS: 1308 patients (850 TKA, 458 THA) were included. 382 patients (29.2%) had BMI < 30 without MetS; 334 (25.5%) had BMI < 30 and MetS; 219 (16.7%) had BMI ≥30 without MetS; and 373 (28.5%) had BMI ≥30 and MetS. Demographic and comorbidity data were significantly different between groups. Having MetS was related to significantly higher rates of CMS-reportable complications compared to those without ($p = 0.045$). Obesity was related to significantly higher rates of discharge disposition other than home ($p <0.001$). There were no significant effects of obesity or MetS with regard to LOS. MetS was found to be a significant risk factor for CMS-reportable complications regardless of BMI (OR=1.45: 95% CI 1.01 – 2.10). Obesity was a risk factor for discharge disposition other than home regardless of MetS (OR=1.5, 95% CI 1.20 – 1.88). There was no interaction evident between obesity and MetS on any outcome ($p >0.3$).

CONCLUSION: MetS increases risk for CMS-reportable complications following THA and TKA regardless of obesity status. The interaction between BMI and MetS is additive only. Obesity is

of less value than MetS in assessing overall risk for CMS-reportable complication following THA and TKA.

Patient Perspective of Direct Anterior Hip Replacement

Abstract ID: Paper 140

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INTRODUCTION: Less invasive approaches for total hip arthroplasty have garnered much attention in the community, as well as media outlets. Data demonstrating the actual differences in these approaches is quite limited at this time. We are not aware of any data documenting patients' perceptions of the direct anterior approach for total hip arthroplasty. Better surgeon understanding of patient perception may help improve care. The purpose of this study is to collect information regarding patient perceptions of the direct anterior approach for total hip replacement.

MATERIALS AND METHODS: We surveyed consecutive group of 166 new patients being seen for hip arthritis in our outpatient clinic. Demographic data, as well as their knowledge of the direct anterior approach was collected, as well as a number of questions on a 5 item Likert scale.

RESULTS: Forty-six (28%) responded that they were aware of the direct anterior approach. Patients learned about the direct anterior approach from friends and family (58%), healthcare professionals (38%), and other sources in the remaining. Respondents agreed or strongly agreed that the direct anterior approach is: less painful (70%), reduces the amount of time spent on a cane after surgery (70%), damages tissues less (68%), allows patients to more quickly return to work (64%), and allows for shorter hospital stays (62%), compared to other procedures. Also, 30% felt there is a consensus among surgeons that the direct anterior approach is the safest and most effective procedure for total hip replacement.

CONCLUSION: Many patients are unaware of alternative approaches for total hip arthroplasty, only 28% in this study. Additionally, a majority of health care information is transmitted by friends and family members. The patients' perceptions are inconsistent with published data about the direct anterior approach, and are affected deeply by the opinions of those around them.

Total Hip Arthroplasty Using a Tapered Femoral Component in Patients Younger Than 50 Years: 25-Year Average Follow-Up

Abstract ID: Paper 141

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INTRODUCTION: This study evaluated the clinical results, incidence of osteolysis, and efficacy of fixation using an uncemented tapered femoral component in patients aged less than 50 years. At a mean follow-up of 25 years, no femoral component required revision for aseptic loosening and 90% remained in place and well fixed. Mild osteolysis was identified in 9%.

METHODS: One hundred and eight consecutive primary uncemented total hip arthroplasties (THA) were performed in 91 patients under age 50 years between 1983 and 1990. All surgeries were performed by a single surgeon. All femoral components were titanium, had a rectangular tapered geometry and were proximally porous coated with plasma spray. The average age of the patients was 36.4 years (range 20-49 years). The outcome of every hip was determined. Fifteen patients (17 hips) died prior to a 20-year minimum follow-up period. No stem had been revised in these patients. Therefore, 91 hips in 76 patients were reviewed at a mean follow-up of 25 years (range 20-29 years). Detailed follow-up was obtained on every living patient. All 108 hips were included in the survivorship analysis.

RESULTS: No femoral component required revision for aseptic loosening. Five well-fixed stems (5%) were revised during acetabular revision. Three stems (3%) were revised for late sepsis, and one stem (1%) was exchanged postoperatively for a sciatic nerve palsy. The mean Harris hip score improved from 55 preoperatively to 92 at final follow-up. No femoral component was rated loose by radiographic criteria. Osteolysis occurred in 8 hips (9%). Survivorship analysis estimated a 90% survival for the femoral component at 29 years (95% CI 0.82 to 0.95).

DISCUSSION AND CONCLUSION: The most important finding of this report was the low incidence of femoral loosening, revision, and osteolysis. These results demonstrate that excellent durability can be achieved using an uncemented tapered stem in young patients out to 29 years.

Anterior vs. Posterior Total Hip Arthroplasty (THA) – Patient Reported Outcomes in Early Postoperative Period

Abstract ID: Paper 142

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INTRODUCTION: The anterior approach has been reported to improve early outcomes following THA up to 6 weeks postoperatively; however, previous investigations report few observed time-points. Patient Reported Outcomes Measurement Information System (PROMIS) is a reliable, valid, tool that measures patient self-reported health status and ability to function. In this study, we investigate the effect of surgical approach on THA outcome via weekly PROMIS assessment and traditional outcome measures.

METHODS: 65 patients undergoing THA for primary osteoarthritis with one of two fellowship-trained adult reconstructive surgeons (one surgeon performs anterior and the other performs mini-posterior) at the same institution are studied. All patients were managed using the same protocolled pathway. At weekly intervals for 6 weeks, outcome scores including Modified Harris Hip Score (mHHS), VAS pain score, and PROMIS - Physical Function and Pain Interference were recorded and compared to baseline. Inpatient data was also tracked.

RESULTS: The anterior approach showed significantly decreased length of stay, 1.6 vs. 1.9 days ($p=0.04$). Patients undergoing anterior THA had significantly lower VAS pain scores until 4 weeks postoperatively ($p<0.0001$) and improved mHHS until 5 weeks postoperatively ($p=0.005$). The anterior approach was also associated with improved PROMIS - Pain Interference scores until 5 weeks postoperatively ($p<0.0001$). Despite the fact that patients undergoing posterior THA had a higher level of baseline PROMIS - physical function, the anterior group had superior scores through all 6 weeks ($p=0.006$).

CONCLUSION: Patients undergoing anterior THA had a significantly decreased length of stay and superior PROMIS - Physical Function at all time points. VAS pain, PROMIS - Pain Interference, and mHHS scores were superior for the anterior group but equalized at 4 and 5 weeks, respectively.

High Risk of Wound Complications Following Direct Anterior Total Hip Arthroplasty in Obese Patients

Abstract ID: Paper 143

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INTRODUCTION: Direct anterior total hip arthroplasty (THA) is associated with perioperative complications, including wound problems. The goals of this study were to (1) describe the incidence, characteristics, and treatment of wound complications following direct anterior THA by a single surgeon, (2) identify potential risk factors for wound complication following direct anterior total hip arthroplasty, and (3) compare the rate of wound complication following direct anterior THA with patients undergoing primary THA via a posterolateral approach during the same time interval.

METHODS: We retrospectively reviewed 716 direct anterior THAs performed by a single surgeon and 3,040 posterior THAs from our institution performed from 2010-2014. Patient demographics and surgical factors were reviewed. Our study group (DA patients) consisted of 716 patients with a mean age of 64 years (range, 19-91 years), mean body mass index (BMI) of 29.4 kg/m^2 (range, 15.6-49.6 kg/m^2), and 362 (51%) females and mean follow-up of 12 months (range, 2-46 months). Patients in the posterior comparison group had a mean age of 62 years (range, 11-97 years), mean BMI of 30.1 kg/m^2 (range, 15.6-74.9 kg/m^2), and included 1,540 (51%) females with an average follow-up of 13 months (range, 2-48 months).

RESULTS: Wound complications were noted in 1.7% of DA cases, with 75% requiring wound revision. A similar rate of wound complication was noted in the posterior group (1.9%, p=0.76). In DA patients, risk factors for wound complication included BMI ≥30 kg/m^2 (HR 4.3, p=0.018) and BMI ≥40 kg/m^2 (HR 19.3, p<0.0001). In comparison, BMI ≥30 kg/m^2 and BMI ≥40 kg/m^2 were relatively less predictive in the posterior group with hazard ratios of 1.4 (0.8-2.3, p=0.22) and 3.8 (1.9-6.8, p=0.0002), respectively.

DISCUSSION AND CONCLUSION: We found that the incidence of wound infection was similar between DA and posterior approach primary THA at our institution. However, obesity was a stronger risk factor for wound complication in DA patients. Obesity (particularly those with BMI ≥40 kg/m^2) was a major risk factor for wound complication following direct anterior THA, with a considerable proportion of wound complications requiring reoperation. Although no patients with wound complication went on to develop deep infection, these findings should be taken into consideration prior to performing direct anterior THA, particularly in morbidly obese patients.

The Direct Anterior Approach is a Risk Factor for Early Failure in Cementless Total Hip Arthroplasty: A Multi-Center Study

Abstract ID: Paper 144

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INTRODUCTION: The direct anterior approach (DAA) for total hip arthroplasty (THA) continues to be marketed heavily with claims of superiority over other approaches. Femoral exposure can be technically challenging and potentially lead to early failure. The purpose of this study was to examine whether DAA is associated with early femoral component failure and revision THA.

METHODS: A retrospective review of 484 consecutive early revision THAs at three academic centers from 2011 through 2014 was performed. Surgical approach for the primary procedure was unavailable for 40 hips, leaving 444 early revision THAs for analysis. Early revision was defined as being within 5 years of the primary THA. Hemi-arthroplasties, conversion THAs and re-revisions were excluded. Primary surgical approach was documented for each revision THA, along with the time to revision and etiology of failure. Statistical analysis was performed with $p<0.05$ considered significant.

RESULTS: The mean time to revision was 4.0 months (range, 0-60). 44.1% of early failures were originally via the DAA, compared to 32.0% via the direct lateral and 23.6% via the posterior approach ($p<0.001$). Of the 123 femoral component failures due to fracture or aseptic loosening, 47.2% of them were performed through the DAA, compared to 17.1% for the posterior approach ($p=0.001$). Of the 42 failures due to instability, 47.6% were performed via the posterior approach, compared to 38.1% via the DAA and 14.3% via the direct lateral approach ($p=0.002$).

CONCLUSION: Despite the claims of early recovery and improved outcomes with the DAA, this approach is associated with a larger than anticipated percentage of early failures, including femoral component loosening and fractures, within five years compared to the posterior approach. Surprisingly, a relatively high percentage of early failures due to instability were originally performed via the DAA surgical approach, despite claims of minimal dislocation risk.

SIGNIFICANCE: This study provides evidence concerning the risks of the DAA that should be considered when contemplating adoption in practice or marketing this surgical approach and should be discussed with patients. Further study in the longer term is required to determine if improvements in instrumentation, training, and implementation are able to mitigate the risks reported in this study.

A Randomized Clinical Trial of Two-Incision vs. Mini-Posterior THA: Differences Persist at Five Years

Abstract ID: Paper 145

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INTRODUCTION: Minimally invasive total hip arthroplasty (THA) approaches such as the two-incision technique conceptually lead to less pain and faster recovery. However, a previous randomized clinical trial at our institution demonstrated slower recovery of a two-incision THA when compared to a mini-posterior THA at 2 years. The primary aim of this study is to report a concise 5-year follow-up.

METHODS: In this randomized clinical trial, 36 hips received a two-incision THA and 35 hips received a mini-posterior THA. Clinical and radiographic outcomes, survivorship, and complications were analyzed at a mean follow-up of 5 years. The demographics between the two groups were similar. Mean age was 66 years.

RESULTS: At most recent follow-up, the mean Harris hip score (HHS) was 85 in the two-incision group and 87 in the mini-posterior group (p=0.4). Radiographic analysis revealed two (6%) femoral components with non-progressive radiolucent lines in the two-incision group. In the mini-posterior group, there was one femoral component (3%) with a non-progressive radiolucent line and one (3%) acetabulum with a non-progressive radiolucent line. There were 4 revisions and 2 reoperations (16%) in the two-incision group vs. 1 revision and 2 reoperations (9%) in the mini-posterior group (p = 0.5). Five-year survivorship free of revision or reoperation was 88% in the two-incision group vs. 91% in the mini-posterior group (p=0.55). Overall minor complication rates were 6% in both groups.

DISCUSSION: There was no improvement in early or mid-term clinical outcomes with the two-incision technique. However, there was a slight clinical trend towards a higher rate of revisions and reoperations in the two-incision THA group at mid-term follow-up.

SUMMARY: In this randomized clinical trial, the previously demonstrated short-term advantage of the mini-posterior THA over the two-incision THA persisted at 5-year follow-up.

Keywords: Two-Incision; Total Hip Arthroplasty (THA); Mini-Posterior Incision; Minimally Invasive Surgery (MIS)

Tranexamic Acid Does Not Increase VTE in Patients With Prior VTE Undergoing Total Joint Arthroplasty

Abstract ID: Paper 146

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INTRODUCTION: Tranexamic acid (TXA) has been shown to be a safe and effective intervention to reduce blood loss and transfusions after total joint arthroplasty. Recent studies suggest that these findings are generalizable to patients who are at high risk for venous thromboembolism (VTE). The purpose of this study was to determine the risk of recurrent VTE in patients receiving TXA during primary total hip arthroplasty (THA) and total knee arthroplasty (TKA).

METHODS: We retrospectively reviewed 234 cases in patients with a documented VTE history who were treated with TXA during primary THA or TKA between 2000 and 2012. These patients were then compared to a cohort of 1,205 patients with prior VTE who did not receive TXA. VTE rates were evaluated at 90 days postoperatively. The mean age was 69 years with a slight female predominance.

RESULTS: Of the 234 cases in which TXA was administered, there were 10 (4%) VTE events documented. Of the 1,205 cases in which TXA was not administered, there were 72 (6%) VTE events documented. There was no statistical difference between the groups (p 0.306).

CONCLUSION: This study suggests that the use of TXA in total joint arthroplasty in patients with prior history of VTE is safe.

Preoperative and Discharge Predictive Tools for 30-Day Readmission Following Total Hip Arthroplasty

Abstract ID: Paper 147

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INTRODUCTION: Unplanned 30-day readmission after total hip arthroplasty (THA) is associated with large financial consequences for the hospital, including a reduction in the total amount of reimbursement payments and potential penalties if incidence is too high. The development of multivariable clinical tools for predicting 30-day readmission after primary and revision THA will help clinicians identify high-risk patients for readmission, both preoperatively and at discharge.

METHODS: Using data from the New York and California State Inpatient Databases from 2007-2011, 182,354 primary THA and 25,398 revision THA admissions were identified. Several demographic variables (n=5) and comorbidities (n=30) were used to create a model to preoperatively predict a patient's probability of 30-day all-cause, unplanned readmission. Additional inpatient data (n=7) in combination with the variables used for the preoperative model were used to create a model to predict the likelihood of readmission at discharge. The models were used to create risk calculators that can be administered preoperatively and at the time of discharge to determine the readmission likelihood for each patient.

RESULTS: Overall, 30-day readmission rates were 4.6% for primary THA and 9.5% for revision THA. The most common reasons for readmission among both groups included dislocation of the prosthetic joint, infection, and hematoma. Multivariate analysis identified several risk factors for readmission, of which metastatic cancer and steroid use prior to index surgery were identified for both primary and revision THA. The c-statistics indicate that including inpatient variables in the models (Primary THA, c = 0.679; Revision THA, c = 0.675) yielded slightly better results than using preoperative variables alone (Primary THA, c = 0.668; Revision THA, c = 0.656).

CONCLUSION: These risk calculators provide surgeons with a useful tool to help guide more appropriate patient selection for surgery, preoperative optimization, and postoperative interventions that can be directed toward higher-risk patients to reduce readmissions.

Ultrasound Findings in Asymptomatic Patients With Dual Taper Modular Total Hip Arthroplasty

Abstract ID: Paper 148

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INTRODUCTION: The use of metal-on-metal (MOM) and modular total hip arthroplasty (THA) is associated with potentially serious complications including elevated serum metal ion levels, pseudotumor, cardiomyopathy, and neurologic abnormalities. The primary aim of this analysis was to identify any associations between the presence of pseudotumor, serum metal ion levels, and specific dual modular implant components.

METHODS: We evaluated prospectively collected data from 49 patients, mean age 58.4 years, who underwent implantation of modular THA from 01/2004 - 01/2010. The collected data spanned a 5-11 year period from the time of index procedure. Serum metal ion levels, including titanium, cobalt and chromium, were collected in 2012 and 2015. Hip ultrasounds were performed on each patient by a trained musculoskeletal radiologist for evaluation of the presence of soft-tissue pseudotumor. Univariate nonparametric tests were used to compare the two groups: Fisher's exact tests for categorical variables, and Wilcoxon two-group tests for continuous variables. For the purposes of analysis, values that were below the level of detection (LOD) were set to half the LOD. All analyses were performed using SAS 9.4. Statistical significance is set at $p<0.05$.

RESULTS: Eight of 49 patients (16.3%) had pseudotumors on ultrasound examination. The average size measured 35.05 cm^3 (7.35 cm^3 – 130.81 cm^3). In patients without pseudotumor, the serum levels (ng/mL) of titanium, cobalt, and chromium were 3.2 ± 2.7, 4.4 ± 5.7, and 3.4 ± 4.9 in 2012 and 3.6 ± 4.9, 11.3 ± 33.7, and 5.3 ± 10.8 in 2015, respectively. Patients with pseudotumor had titanium, cobalt, and chromium levels of 3.5 ± 2.3, 8.4 ± 8.7, and 6.2 ± 9.4 in 2012 and 4.1 ± 3.4, 6.0 ± 4.5, and 5.1 ± 6.4 in 2015. The ratio of cobalt to chromium was 1.6 ± 1.3 in 2012 and 1.8 ± 1.2 in 2015 in patients without pseudotumor and 2.1 ± 1.2 and 1.9 ± 1.3 with patients with pseudotumor, respectively. There was no statistical correlation between the presence of pseudotumor and age, component pairings (stem, neck, and cup) and any of the serum metal ion levels.

DISCUSSION/CONCLUSION: In this prospective cohort study, the incidence of pseudotumor was 16.3% in asymptomatic patients with modular THA. The presence of pseudotumor did not correlate with component pairings, serum metal ion levels, or cobalt to chromium ratios.

Comparative Analysis of Low and Normal BMI as it Relates to Nutritional Status and Postoperative THA Outcomes

Abstract ID: Paper 149

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INTRODUCTION: Total hip arthroplasty (THA) is one of the most common and successful procedures performed in the United States. Poor nutritional status is a preventable condition resulting from a diet low in nutrients, and commonly presents with low body mass index (BMI). A low BMI score may serve as an objective measure to assist surgeons in fully understanding the nutritional status of their patients. The purpose of this study is to comparatively analyze the effects of low (≤19 kg/m^2) and normal (19-24.9 kg/m^2) BMI and report the impact of both variables on postoperative outcomes and resource utilization.

METHODS: Discharge data from 2006-2012 National Inpatient Sample (NIS) was used for this study. All patients received a primary THA, were eligible for inclusion in this study. The included population was divided into low BMI and normal BMI. All groups were matched for 27 comorbidities using the Elixhauser comorbidity index. Their in-hospital postoperative outcomes were then comparatively analyzed. Using SAS 9.2 and Proc-FREQ statistics software univariate analysis, logistic regression models, and chi squared results were generated. Data was analyzed using odds ratio (OR), 95% confidence intervals (CI), and p-values.

RESULTS: A total of 3550 patient samples were split into two cohorts and matched. The patient population was statistically analyzed for both low and normal BMI groups relative to: demographics, comorbidities, postoperative outcomes, and resource utilization. In regards to postoperative outcomes, patients with lower BMI had a higher risk of postoperative anemia (OR 2.65; 95% CI, 2.30-3.07) compared with normal patients. Analysis of resource utilization demonstrated low BMI patients had longer lengths of stay (LOS) (5.30 days vs. 4.40 days, p=.021), higher total hospital charge (USD 61346.8 vs. 42990, p<.0001), and higher daily charge (USD 14508.9/day vs. 10681.5/day, p<.0001).

CONCLUSION: As the number of patients undergoing THA continues to rise, there is more interest in the nutritional status of THA patients and the effects of BMI on postoperative outcomes. In comparison to patients with normal BMI, having lower BMI has been associated with higher risk of postoperative anemia, LOS, and hospital charge. Low BMI may be associated with poor nutrition resulting in delayed wound healing possibly explaining these findings. Continued research is needed to study the impact of low BMI on postoperative outcomes and resource utilization following THA.

Hip-Spine Syndrome: The Relationship Between Cam-Type Deformity and Osteoarthritis of the Spine

Abstract ID: Paper 150

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INTRODUCTION: The term hip-spine syndrome (HSS) has traditionally been used to describe patients with coexisting hip arthrosis and lumbar spine disorders. To date, the treatment of hip pain in the setting of HSS has focused on patients with hip arthrosis, but the implications for treatment of prearthritic hips in the setting of HSS has generally been ignored. We, therefore, examined a large osteological collection to assess the relationship between cam-type deformity of the proximal femur and osteoarthritis of the spine (SOA).

METHODS: Alpha-angle (AA) and anterior femoral neck offset (AFNO) were measured on paired femurs of 550 well-preserved cadaveric skeletons (1100 total femurs) from the Hamann-Todd Osteological Collection using standardized cephalocaudal images. Degenerative disease of these specimens' lumbar spine was graded from 0 to 4 using an established grading system. Proximal femurs demonstrating obvious arthritic changes that could potentially alter AA and AFNO measurements were excluded. Correlations between AA and AFNO with SOA were evaluated via multiple regression analysis.

RESULTS: The average patient age was 47.8±16.2 years. There were 456 males and 94 females, 335 Caucasians and 215 African-Americans. The mean AA and AFNO were 54.4°±11.4° and 6.8 mm±1.5 mm, respectively. There was a significant correlation between increasing AA and SOA (standardized beta [stdB]=0.061, p=0.041). There was also a significant correlation between decreasing AFNO and SOA (stdB= -0.067, p=0.025). As expected, there was a strong correlation between age and SOA (stdB=0.582, $p<0.0005$). Inter-rater reliability was 0.90 for combined lumbar SOA scores. Inter-observer ICC was 0.81 and 0.88 for AA and AFNO measurements, respectively.

DISCUSSION AND CONCLUSION: Many authors have hypothesized that alterations in hip range of motion can lead to increased stress on the lumbar spine. Additionally, recent data has suggested that individuals with cam-type deformity of the proximal femur likely have altered spino-pelvic anatomy and sagittal alignment, and as a result, unfavorable biomechanical adaptations at the level of the lumbar spine. Our results are the first to demonstrate that the cam-type deformity markers of increasing AA and decreasing AFNO are significant predictors of SOA. Cam deformity in the younger individual may contribute to the accelerated development of SOA in later life; the improvement in hip internal rotation after femoral osteoplasty to correct cam deformity may decrease lumbopelvic stress and pain and have the long-term benefit of lower rates of SOA. A more thorough understanding of the hip-spine connection will likely aid in the evaluation and management of femoroacetabular impingement.

The Interaction of Obesity and Diabetes in Determining Risk of Complication Following Total Joint Arthroplasty

Abstract ID: Paper 151

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INTRODUCTION: Obesity and diabetes have been identified as contributors to risk in TJA. This investigation seeks to assess and quantify the interaction between obesity and diabetes on risk of complication following TJA.

METHODS: We utilized regression modeling of the ACS-NSQIP dataset from 2005-2012 to assess risk for Centers for Medicare Services (CMS)-reportable complications (pneumonia, myocardial infarction, death, pulmonary embolism, surgical site infection, surgical site bleeding, catheter-associated urinary track infection, mechanical complication, and readmission) in patients undergoing TJA. BMI was expressed as a continuous variable using piecewise restricted cubic splines. Diabetes was coded as no DM, non-insulin dependent (NIDDM), or insulin dependent (IDDM). The risk accrual interaction between obesity and diabetes was assessed. The spline fit model of BMI was examined for any deflection points.

RESULTS: 82,006 patients were identified and overall incidence of CMS-reportable complications was 5039 (6.1%). We tested for interactive effects between BMI specified with cubic splines and DM and found no interaction ($p=0.179$). Diabetes was associated with increased risk of complications irrespective of BMI (NIDDM [OR 1.14, 95% CI 1.05-1.24], IDDM [OR 1.66, 95% CI 1.47-1.88]). Any BMI with IDDM conveyed increased risk compared to NIDDM or No DM ($p<0.001$). Any BMI with NIDDM conveyed increased risk compared to no DM ($P<0.007$). Spline fit representation of BMI and risk probability showed no deflections corresponding to World Health Organization (WHO) obesity class. Obesity-related risk transitions from linear to exponential at a BMI of 45. A BMI of 40 without diabetes conveys less risk for CMS-reportable complications than BMI of 25 with IDDM.

CONCLUSION: Diabetes increases risk for CMS-reportable complications following TJA irrespective of BMI. The interaction between obesity and diabetes is strictly additive. Obesity, when represented as a continuous variable, demonstrates the arbitrary nature of surgical BMI cut-offs.

Dual Mobility Liners for Revision Total Hip Arthroplasty (THA) Decrease Early Postoperative Instability

Abstract ID: Paper 152

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INTRODUCTION: Hip instability remains a major cause of early failure in revision arthroplasty, with dislocation rates reported as high as 28%. The purpose of this study was to evaluate postoperative instability within 90 days of revision in patients who received dual mobility components.

METHODS: A multicenter retrospective review was performed on 118 consecutive patients who underwent revision THA with a dual mobility liner. All patients had at least one prior open hip surgery, dual mobility usage at time of revision, and at least 90 days follow-up to monitor for early instability. Postoperative instability was defined as either dislocation or pullout of the acetabular component. Demographic and surgical data were collected, and postoperative complications were recorded for each patient.

RESULTS: Seventeen of 118 (14.5%) patients sustained complications; however, just seven of these were related to early postoperative instability (5.9%). Dislocation accounted for five of these (3.6%), while pullout of the acetabular component accounted for two (1.7%). Average ASA scores were significantly different (p=0.03) between postoperative instability (3.3±0.49) and non-postoperative instability groups (2.8±0.65). While not statistically significant, there were tendencies of postoperative instability among patients with increasing BMI (p=0.33), age (p=0.18), and number of prior revisions (p=0.31). Other trends included posterior/posteriorlateral surgical approach (100% of dislocation group vs. 80.2% of stable hips), a deficient abductor mechanism (43% of dislocation group vs. 27% of stable hips) (p=0.37) and a septic THA as indication for revision (57.1% of dislocation group vs. 19.8% of stable hips) (p=0.14). Off label usage did not demonstrate statistical significance among groups (42.9% vs. 40.5%) (p=0.90).

CONCLUSION: Usage of dual mobility components in revision surgery shows encouraging results in regards to early postoperative instability. In order to select candidates most likely to benefit from dual mobility components in revision surgery, further studies with larger numbers are needed.

Anatomic Hip Center Decreases 20-Year Acetabular Component Loosening in Cemented Crowe-II THAs

Abstract ID: Paper 153

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INTRODUCTION: Optimal positioning of acetabular components in patients with hip dysplasia continues to be debated. In this study, we sought to determine if long-term acetabular loosening and revision rates were correlated with initial cup position relative to (1) superior displacement ≥15 mm from the approximate femoral head center (AFHC), (2) superior displacement ≥35 mm from the interteardrop line (ITL), (3) presence within the true acetabular region (TAR), and (4) location within the four-zone system (1-inferomedial, 2-superomedial, 3-superolateral, and 4-inferolateral).

METHODS: We reviewed 145 cemented THAs performed in patients with Crowe II dysplasia between 1969 and 1980. Hips were assessed for radiographic evidence of aseptic loosening, as well as revision for aseptic loosening. Given the long-term nature of this study, a competing-risk analysis was utilized to determine cumulative incidence of cup loosening and revision for aseptic loosening, with other-cause revision and death considered to be competing risks. At most recent follow-up, 44 hips were in patients alive and available for follow-up. Mean age at index arthroplasty was 51 years, with a mean follow-up of 26 years.

RESULTS: Hips with an anatomic hip center had significantly lower acetabular component loosening and aseptic revision rates. Radiographic loosening was less likely for hip centers placed within the TAR (p=0.01), <15 mm superior to the AFHC (p=0.001), <35 mm superior to the ITL (p=0.001), or located within zone 1 (p=0.0002). Cup revision for aseptic loosening was more likely for hip centers placed ≥ 35 mm superior to the ITL, with a cumulative incidence of 26% vs. 18% at 20 years (p=0.01).

DISCUSSION/CONCLUSIONS: An anatomic hip center lead to lower acetabular component loosening and revision rates following 145 cemented THA done for Crowe II dysplasia. A noticeable divergence in survival was noted at long-term (20-year) follow-up, indicating the importance of accounting for death and other-cause revisions by including analysis with a competing-risk model in long-term investigations.

Day of Week Does Not Influence Length of Stay in Primary Joint Arthroplasty

Abstract ID: Paper 154

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INTRODUCTION: Recent work has suggested increased length of stay (LOS) for primary total joint arthroplasty (TJA) is based upon the surgery day of week. Our hypothesis was LOS and disposition to home were unaffected by day of week in our highly managed TJA program.

MATERIALS AND METHODS: A retrospective review was performed on 2,968 TJA (2,302 primary; 666 revisions) performed between 2012 – 2014. We recorded surgery day of the week, LOS, and discharge disposition. All patients participated in our Joint Academy (JA) program, which includes preoperative teaching, hospitalist coverage, APN in-hospital care, and oversight by a joint coordinator.

RESULTS: Within the primary TJA group, there was no significant difference in LOS (1.45, 1.59, 1.69, 1.58, and 1.81) related to the surgery day of the week (M, T, W, TR, F, respectively). Further, there was no significant difference in percent discharged to home within the primary TJA group, which was greater than 90% for all days of the week. Of all days, LOS for revision TJA (1.51, 1.15, 1.55, 2.49, and 2.03 for M through F) only differed significantly for Thursday ($p<0.05$).

CONCLUSIONS: As the volume of joint replacement increases and alternative payment models are implemented, programs that allow for decreased LOS and discharge to home regardless of operative day of the week are critical. In our highly managed JA program, LOS was unaffected by the surgery day of the week for primary elective total joint replacement patients.

Patient Perceptions of Sleep Quality Before and After Primary Total Joint Replacement

Abstract ID: Paper 155

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INTRODUCTION: Sleep disruption is a common complaint in patients with degenerative joint disease pre- and postoperatively. Sleep disturbance and its impact on clinical outcomes following joint replacement has rarely been investigated. The purpose of this study is to assess patient perspectives and expectations regarding sleep quality before and after primary total hip (THA) or knee replacement (TKA).

MATERIALS/METHODS: A total of 103 patients who sought primary THA or primary TKA from one orthopedic surgeon completed a questionnaire during preoperative and first postoperative clinic visits. Exclusion criteria were: not scheduled for primary THA or primary TKA; or previous hip, knee, or spine surgery in previous 3 months. The first part of each questionnaire consisted of 22 questions regarding demographics and medical history, current sleeping habits, and patient perspectives on the association between sleep quality, joint replacement, and daily activities. The second portion of the questionnaire consisted of the Epworth Sleepiness Scale, an 8-question survey assessing daytime sleepiness. Interim analyses were performed on 68 patients.

RESULTS: Nearly 80% of patients denied history of diagnosed sleep disorder or sleep medication use. Mean duration between surgery and postoperative survey completion was 35.8 + 25.7 days. The percentage of patients who reported falling asleep in 15 minutes or less decreased from 60% preoperatively to 47% postoperatively. The number of nightly sleep disruptions did not change substantially postoperatively. However, "pain in surgery joint" was a commonly reported cause for sleep disruption and increased from 31% preoperatively to 41% postoperatively. Nearly half of patients (46%) reported dissatisfaction with their postoperative sleep quality. Over half (53%) of patients had anticipated joint replacement would improve their sleep, but only 28% reported actual improvement in sleep following joint replacement.

CONCLUSION: Our findings suggest sleep disturbance is common before and after primary THA and primary TKA. While time to fall asleep and sleep duration did not change substantially in the early postoperative period, many patients (41%) reported pain in their surgery joint as a cause of postoperative sleep disruption. This early disturbance in sleep likely improves with longer follow-up, but this high incidence may warrant some prophylaxis for insomnia in properly selected patients. Given the importance of sleep quality in enhancing functional outcomes and postoperative recovery, it is important for orthopedic surgeons to manage patients' expectations while working with them to optimize sleep quality after hip and knee replacement.

The Results of Second Two-Stage Reimplantations for Periprosthetic Hip Infection

Abstract ID: Paper 156

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INTRODUCTION: Failed two-stage reimplantation with subsequent infection is a devastating outcome following two-stage exchange arthroplasty for periprosthetic hip infection. Attempts at further two-stage reimplantation procedures are fraught with difficulties without clear guidelines for treatment or prognosis. A staging system has been previously described in an attempt to stratify patients according to infection type, host status, and local soft tissue status. This system may prove useful when developing treatment algorithms for this difficult patient population. The purpose of this study was to report the results of subsequent two-stage reimplantation following a failed two-stage protocol for periprosthetic hip infection, as well as identify risk factors for failure, and complications associated with these procedures.

METHODS: We retrospectively identified 21 patients who underwent a second two-stage exchange arthroplasty for periprosthetic hip infection from 2000 to 2013. These patient's records were examined for outcomes following these procedures, risk factors for failure, and complications. Minimum follow-up was 2 years (mean 3.5 years).

RESULTS: Eight patients (38%) underwent re-revision for infection with 17 patients (81%) undergoing revision for any reason. The most common reasons for revision were infection (8 patients) and instability (5 patients). Seven of 8 patients revised for infection were classified as an immunocompromised host (B or C) and had a compromised local extremity grade (2 or 3). When isolating type A hosts, infection was eradicated in 4 out of 6 patients (67%). Recurrence of infection was diagnosed in 36% of medically compromised hosts (type B) and 50% of medically ill patients (type C) following a second two-stage reimplantation. A constrained or dual mobility construct was used in 33% patients at the time of reimplantation. A total femur or proximal femoral replacement was utilized 30% of cases at the time of reimplantation. A causative microorganism was identified in 19 patients with 9 (43%) of these patients becoming infected with a different microorganism than the initial periprosthetic hip infection. Eight of the patients free of revision for infection were placed on lifelong antibiotic suppression. Complications occurred in 11 patients (52%). No patients were free of gait aids at final follow-up.

CONCLUSION: This data suggests that expectations following a second two-stage exchange arthroplasty for periprosthetic hip infection should be tempered as the failure rate of this procedure is high with considerable patient morbidity and complications associated with these procedures.

Intraoperative Temperature Monitoring in Total Hip and Knee Arthroplasty

Abstract ID: Paper 157

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INTRODUCTION: Total hip and knee arthroplasty (THA and TKA) are common and successful orthopedic procedures. Intraoperative normothermia is a goal outlined by many surgical guidelines, but limited evidence exists regarding hypothermia's effect in orthopedic patients. The purpose of this study is to determine the incidence of intraoperative hypothermia in the setting of TKA and THA, and to evaluate the impact of hypothermia on complications and outcomes.

MATERIALS/METHODS: A retrospective chart review was performed of clinical records from 2,580 consecutive patients who underwent knee or hip arthroplasty at two academic hospitals between January 2011 and December 2013. After data collection and chart review, 2,397 patients were included for analysis. Chart review recorded patient demographic data, surgery-specific data, postoperative complications, length of stay, and 30-day readmission. Statistical analysis included non-normal distributed continuous variables analyzed by non-parametric Wilcoxon test. Categorical variables were examined using chi-squared tests. All statistical analysis was performed using SAS Version 9.3.

RESULTS: Overall incidence of hypothermia was 38.3%, with 45.6% in THA and 33.4% in TKA. The use of general anesthesia had significant association with patients experiencing mean intraoperative hypothermia in all sub-group analyses. Arthroplasty (THA and TKA as a combined cohort) demonstrated increased estimated blood loss (EBL) and intravenous fluid (IVF) use associated with hypothermia. Arthroplasty and THA sub-group analysis demonstrated a higher rate of transfusion associated with hypothermia. THA demonstrated an association with prolonged operating room (OR) time and surgical time associated with hypothermia. There was no significant increased risk of infection, venous thromboembolic events, myocardial infarction, stroke, or re-admission associated with hypothermia. Those patients who had the use of an active re-warming device experienced a significantly higher rate of intraoperative hypothermia in both the arthroplasty and THA group (Arthroplasty: 39.1% vs. 29.2%, $p = 0.004$; THA: 46.8% vs. 29.2%, $p = 0.009$).

DISCUSSION/CONCLUSIONS: The incidence of intraoperative hypothermia remains high in patients undergoing total joint arthroplasty, with THA at higher risk than TKA. General anesthesia is significantly associated with intraoperative hypothermia compared to regional anesthesia. Intraoperative hypothermia does not appear to significantly affect complications in patients undergoing total joint arthroplasty, but may increase intraoperative blood loss and potentially influence transfusion requirements postoperatively in THA. The use of an active re-warming device does not necessarily correlate with intraoperative normothermia.

Ambulatory Anterior Total Hip Arthroplasty is as Safe and More Cost Effective Than in the Hospital

Abstract ID: Paper 158

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INTRODUCTION: The current health care environment places an emphasis on implementing cost control measures while achieving optimal clinical outcomes. The purpose of this study was to describe our experience with anterior supine intermuscular total hip arthroplasty (ASI THA) performed at an ambulatory surgery center (ASC), and to compare episodes of care complications and costs to the same procedure performed in a hospital.

METHODS: The charts of 70 patients were reviewed retrospectively; 35 patients with ASI THA performed at an ASC were matched according to medical comorbidities to 35 patients with the same operation performed in a hospital. Operative time, blood loss, length of postoperative stay, complications, and Visual Analog Scale (VAS) pain scores were compared. After obtaining patient consent, costs were derived from insurance explanation of benefits documentation and compared between the two groups. Analysis of variance was used to evaluate differences between groups, with $p<0.05$ considered statistically significant.

RESULTS: ASI THA performed in an ASC resulted in a significantly shorter length of postoperative stay (ASC=13.4 hours, HS=38.0 hours, $p<0.0001$) and superior VAS scores at 3 months postoperatively (ASC=0.4, HS=0.8, $p=0.03$) than the hospital cohort. There were no significant differences between groups regarding operative time, blood loss, or complications. Costs were significantly different between the two groups (ASC=$29,421, HS=$ 41,858) with ASC cases saving $12,437 over hospital procedures ($p<0.0001$).

CONCLUSION AND DISCUSSION: A shorter length of stay and less postoperative pain with no difference in complications was found for the ASC group relative to the hospital cohort. Cost savings was significant, with the surgery center group saving an average of $12,437. Further investigation will evaluate longer-term outcomes and cost effectiveness of ASI THA performed on an outpatient basis.

The Effect of Smoking on 30-Day Postoperative Complications After Total Hip Arthroplasty: A Propensity Score Matched Analysis

Abstract ID: Paper 159

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INTRODUCTION: Total hip arthroplasty (THA) is a common, and effective procedure for the treatment of degenerative hip pain with nearly half a million procedures performed in the United States in 2014. As a result, complications, although low in incidence, are burdensome to the national health care budget. Costly complications are the target of national quality initiatives and patients and providers are interested in identifying targets for risk mitigation. Smoking has been linked to many health issues, but its role in perioperative complication following THA is less well known. This study aims to identify smoking's independent contribution to risk of short-term complication following THA using a matched and adjusted propensity score analysis.

METHODS: All patients undergoing THA between 2011-2012 were selected from the American College of Surgeon's National Surgical Quality Improvement Program's (ACS-NSQIP) database. Exclusion criteria were bilateral procedures, concomitant procedures, diagnosis other than osteoarthritis, and patients with missing data. Outcomes of interest included rates of readmission, reoperation, mortality, surgical complications, and medical complications. To eliminate differences in demographics, comorbid diseases, laboratory values, and operative factors between smokers and non-smokers, a propensity score was used to generate a 1:1 match. A propensity-score adjusted logistic regression was subsequently used to generate adjusted odds ratios.

RESULTS: 60,353 patients were identified from the NSQIP database. 12,588 patients met inclusion criteria for the study, out of which 1,501 (11.9%) of the patients were smokers. After adjusting for differences between smoking and non-smoking cohorts, smokers were found to have a higher rate of deep surgical site infection (0.6% vs. 0.1%, p=0.034), sepsis (0.8% vs. 0.3% p=0.045), and readmission (4.0% vs. 2.7%, p=0.041) compared to non-smokers. Smokers were over 3 times as likely to be readmitted (OR 3.3, 95% CI 1.4-7.7), and had a higher likelihood of overall surgical complication (OR 1.8, 95% CI 1.2-2.8). Rates of medical complications (8.7% vs. 10.1%, p=0.184) and mortality (0.1% vs. 0.1%, p=1.0) were comparable.

CONCLUSION: Using matched and adjusted propensity-scoring analysis to rigidly control for confounders in a large nationally representative database, we find smoking to be associated with a higher rate of overall surgical complication, deep surgical site infection, and sepsis following THA. In addition, smokers are greater than 3 times more likely than non-smokers to be readmitted following THA. Smoking is a modifiable risk factor adversely affecting outcomes and quality following THA and is an ideal candidate for risk mitigation efforts prior to surgery.

MAOA BREAKOUT SESSION #12
PEDIATRICS/OTHER
April 16, 2016

Does Using an EMR Template Improve Documentation for Pediatric Supracondylar Humerus Fractures?

Abstract ID: Paper 160

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INTRODUCTION: Pediatric supracondylar humerus fractures are associated with a relatively high incidence of nerve injury and emergent issues such as compartment syndrome; therefore, it is imperative that documentation be complete. Multiple studies have explored the possibility of a documentation template to collect more complete and accurate electronic medical record (EMR) data. However, the use of an orthopedic specific EMR template to document an acute injury has not been reported to our knowledge. The purpose of this investigation is to compare the completeness of orthopedic EMR documentation with and without the use of a template for pediatric supracondylar humerus fractures.

METHODS: An IRB-approved retrospective review identified 86 supracondylar humerus fractures (types II-IV) presenting to a single pediatric institution over one year. The orthopedic history and physical was documented using a template in 29 cases (templated group) and was not used in 57 cases (non-templated group). The completeness of the EMR documentation for the two groups was compared. Data analyzed included clinical examination findings (sensation, motor, compartment check, capillary refill), number of orthopedic providers, and demographics. Statistics were used to analyze the data.

RESULTS: The EMR documentation in the templated group compared to the non-templated group was more complete in regards to the sensory exam of the hand (100% vs. 91%), radial pulse (100% vs. 98%), the motor status of the ulnar nerve (100% vs. 84%), AIN (100% vs. 89%), and PIN (100% vs. 91%) and compartment checks (93% vs. 47%). However, capillary refill was better documented in the non-templated group than the templated group (81% vs. 62%). The groups were similar in terms of age and fracture type. On average, 5 different orthopedic health care providers participated in the care of the patient from injury to the final office visit.

DISCUSSION AND CONCLUSION: This is the first study to demonstrate that an EMR note using a template improved the documentation of clinical examination findings for pediatric supracondylar humerus fractures at initial presentation. Since compartment syndrome can have serious sequela if untreated, documentation of compartment checks is imperative and was facilitated with the use of the template. Completeness of the EMR note is also important as there were on average five different orthopedic providers that participated in the care of the patient.

Supracondylar Humerus Fractures in Children: Is the Nationwide Epidemiology in the United States Changing?

Abstract ID: Paper 161

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INTRODUCTION: Supracondylar humerus (SCH) fractures are the most common elbow fracture seen in children, yet no studies to date have described the epidemiology of these injuries on a national level. We describe the epidemiology and trends in pediatric SCH fractures in the United States.

METHODS: The Nationwide Emergency Department Sample (NEDS) database from 2006 through 2011 was queried for all pediatric patients (age 0-18) with SCH fractures treated in the emergency department (ED). Weighted estimates were extracted.

RESULTS: The number of estimated nationwide ED visits for pediatric patients (age 0-18 years) with SCH fractures ranged from 49,070 in 2006 to 49,286 in 2011. This consistently represented 0.2% of all pediatric ED visits, with the rate of injury ranging from 57.1/100,000 children in 2010 to 63.3/100,000 children in 2008. The mean age of closed injury was 5.50 ± 0.02 years, with the majority of fractures occurring in children 3-6 years of age (54%). Open injuries accounted for approximately 1% of pediatric SCH fractures. Children with open injuries were significantly older (9.06 ± 0.21 years, $p<0.0001$). There were slightly more SCH fracture-related ED visits among boys than girls, ranging from 0.08-0.1% of ED visits for boys and from 0.07-0.08% for girls. However, this only reached statistical significance in 2010 ($p<0.05$). Boys were more likely to present to the ED with an open fracture (OR=1.43, 95% CI=1.19-1.73, $p<0.001$). From 2009-2011, an estimated 9.5% of SCH fractures were associated with polytrauma (7306/73755 [9.9%] in boys, 6060/66799 [9.1%] in girls, [$p<0.05$]). More fractures occurred during the summer months, with the greatest number of injuries in May and September. Rates of SCH fracture-related ED visits/100,000 children ranged from 8.4-10.7 (Northeast), from 12.0-15.3 (Midwest), from 18.7-26.0 (South), and from 14.7-22.3 (West) ($p<0.05$). Length of stay did not change across the study period (1.46 days). Median total charges for patients treated and discharged from the ED were $1,419, compared to $17,407 in children admitted for surgery ($p<0.05$).

CONCLUSIONS: The incidence of pediatric SCH fracture-related ED visits remained stable from 2006-2011. Children aged 4-6 years account for the highest number of SCH fractures presenting to the ED. Open injuries are rare and are more likely to occur in older children. Regional differences in fracture rate need to be explored further as there may be potential for injury prevention. Benefits of operative management need to be demonstrated in order to justify the additional costs of surgical treatment.

Internal Fixation Improves Outcomes for Unicameral Bone Cysts of Proximal Femur in Children

Abstract ID: Paper 162

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BACKGROUND: There is little data to guide the treatment of unicameral bone cysts (UBC) of the proximal femur. Suggested methods of treatment include corticosteroid injection or curettage and bone grafting with or without internal fixation.

QUESTIONS/GOALS: We sought to review our institution's experience with proximal femoral UBCs and compare the outcomes of those treated with or without internal fixation.

METHODS: Following IRB approval, we conducted a retrospective review of 23 patients treated for UBC of the proximal femur at our institution between 1997 and 2014. Patients were 78% male with a mean age of 12 years (range 5 - 24 years) and mean follow-up of 62 months (range 2 - 438 months). Medical records and radiographs were reviewed to identify demographic and lesion characteristics, as well as treatment specifics, tumor recurrence, and subsequent pathologic fracture.

RESULTS: Tumors were located in the femoral head in 8 patients, intertrochanteric region in 8 patients, and subtrochanteric region in 7 patients. Eight patients presented with a pathologic fracture. Initial treatment included serial steroid injection (n=1), curettage and bone grafting (n=6), internal fixation (n=4), and curettage plus internal fixation (n=12). Mean time to radiographic healing following treatment was 10 months (range, 2-20 months) and return to full activity was 5 months (range, 2-20 months). Multiple procedures were required for 8 (35%) patients prior to radiographic evidence of healing, and 4 (17%) patients sustained a post-intervention fracture. Patients younger than 10 years old (HR 2.6 [95% CI 1.0-7.2], p=0.05), those who presented without a fracture (HR11.2 [95% CI 2.2-204.5], p=0.001), and those whose treatment did not include internal fixation (HR 4.8 [95% CI 1.3-17.2], p=0.02) had an increased risk of recurrence requiring additional treatment. Kaplan-Meier survival free of subsequent treatment was improved when comparing patients treated with internal fixation to those without at 1 year (94% [89-99%] vs. 46% [30-62%]) and 3 years (60% [48-72%] vs. 23% [9-37%]) (Log-rank p=0.01).

DISCUSSION: We observed a significant reduction in recurrence in patients who were treated with internal fixation during their index procedure. Internal fixation should be considered at the time of initial presentation, though prospective studies could further clarify which patients would most benefit from such treatment.

Stress Fracture at the Ischio-Pubic Junction After Periacetabular Osteotomy (PAO) in a Pediatric Population: Nothing to Stress About

Abstract ID: Paper 163

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SUMMARY: Stress fracture at the ischio-pubic junction (IPJ) may occur after a Bernese periacetabular osteotomy (PAO) in an adolescent. It may be occur with an associated pubic rami nonunion but does not seem to affect clinical outcome or require any intervention.

INTRODUCTION: The PAO is a well-accepted surgical intervention for symptomatic acetabular dysplasia in the skeletally mature. Redistribution of stresses through the hemipelvis after PAO may lead to stress fracture at the IPJ.

METHODS: This is an IRB-approved retrospective analysis of patients treated at a single institution with a PAO for symptomatic acetabular dysplasia from 1999-2012. All patients were less than 21 years old at surgery with a minimum 1 year follow-up. Radiographic and clinical records were reviewed to identify the presence of a stress fracture. Radiographic analysis preoperatively and 6 weeks and 1 year postoperatively included the lateral center edge angle (LCEA), Sharp's acetabular index (AI), and acetabular index of the weight bearing zone (AIWBZ). Postoperative modified Harris Hip Scores (mHHS) were compared to patients who did not develop a stress fracture.

RESULTS: 166 patients (187 operated hips), average age 15.6 ± 2.5 years old. Twelve (6.4%) stress fractures were identified in 12 patients. Seven were identified on the initial postoperative films while five were identified after the 6 week visit. Six (50%) healed by two years after surgery; the remaining six (50%) went on to non-union. There were 20 SPR cut non-unions 7(35%) of which had associated stress fractures. Six of these seven went on to non-union. Compared to those without a stress fracture, there was no significant difference in preoperative, six weeks post-operative and final CEA (p=0.94, 0.29, 0.27), SAI (p= 0.95, 0.38, 0.16) or AIBWZ (p = 0.37, 0.21, 0.54). There was no difference in post-operative mean mHHS (p=0.63). Four of seven (57%) patients with Charcot-Marie-Tooth (CMT) developed an IPJ fracture and analysis of pre-disposing factors showed that they were more likely to develop an IPJ fracture than DDH or CP patients. (p=0.001). Patients with an IPJ fracture were older (17.1 vs. 15.5 p=0.05). There was no difference based on patient gender (p=0.22).

CONCLUSIONS: The incidence of stress fracture at the IPJ after a Bernese PAO in the adolescent population is ~6.4% with some occurring at the time of surgery. These fractures are also associated with a non-union at the SPR cut and an underlying diagnosis of CMT. These fractures are not clinically significant and do not merit further intervention when identified.

Physeal Bar Equivalent

Abstract ID: Paper 164

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A “physeal bar equivalent” is the result of an injury to the physis which produces a deformity similar to a physeal bar, but has no bridge of bone from the metaphysis to the epiphysis. It is caused by death of physeal cells in only a portion of the physis. The result is the same as a typical physeal bar; deformity of the metaphysis, physis, and epiphysis, relative shortening of the involved bone, and angular deformity of the limb if the lesion is eccentric. Alternative names for the condition could be: “forme fruste physeal bar” or “pseudo physeal bar”.

Four cases have been identified which fit the above description. All were associated with osteomyelitis and or septic arthritis of the knee in children less than one year of age. The infecting organism was Staphylococcus aureus in all cases. In each case, some growth was achieved from physeal bar equivalent resection. Two cases which were diagnosed early and treated by excision of the area of the damaged physis, required only contralateral surgical physeal arrests near maturity to achieve reasonable limb length equality. Two cases which were diagnosed and treated late gained some length, but required ipsilateral femoral lengthening and corrective osteotomy, as well as contralateral physeal arrests and femoral shortening to treat the limb length inequality and angular deformity.

Early recognition and treatment of this rare condition is the only way to avoid severe limb length inequality and angular deformity.

A physeal bar equivalent is also present in some cases of “fishtail deformity” in the distal humerus.

AIS Patients' Perception of Breast Symmetry Improves After Spinal Fusion

Abstract ID: Paper 165

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SUMMARY: Breast asymmetry is a significant concern for many AIS patients. Spinal fusion (SF) significantly improves patients' perceptions about their breasts.

HYPOTHESIS: Patient concerns about breast asymmetry in AIS are common and improve with SF. These improvements are related to clinical and surgical factors.

STUDY DESIGN: Retrospective review of prospectively collected data using SRS Spine Appearance Questionnaire (SAQ) as the primary outcome measure.

INTRODUCTION: Breast asymmetry is a significant deformity associated with AIS. We sought to determine the percentage of patients who report concerns regarding breast asymmetry and those with improvement after SF.

METHODS: Prospective clinical, radiographic, and surgical data was collected on 474 patients undergoing SF for AIS from 2003-2012. All completed the SAQ preop and at 2 years postop. The SAQ includes two statements regarding breast/chest wall asymmetry and responses are based on a 5 point Leikert scale.

RESULTS: 395 females and 79 males with an average age of 14.4 (+/- 2.0) years and mean preoperative Cobb angle 60.6 (+/-11.5) underwent SF. 68.0% of these patients (including 48.1% of males) identified with the statement "I want to have more even breasts". 78.9% (including 77.2% of males) identified with the statement "I want to have a more even chest in the front". Positive responses before surgery correlated with scoliometer ($p=0.029$) and major curve Cobb angle measurements ($p=0.007$).

At 2 years postop, the average Cobb angle was 26.6 (+/-12.1), and there were a significant number of patients who had at least a 2 point Leikert improvement in their response to either statement ($p<0.0001$). Percentage of patients that identified with the statements: "I want to have more even breasts" and "I want to have a more even chest in the front" decreased to 37% and 34%, respectively ($p<0.0001$). Perceptions of improved breast/chest wall symmetry were not associated with use of apical derotation or Cobb angle correction.

CONCLUSION: Breast asymmetry is a significant concern in AIS patients, including males, and correlates with curve magnitude. Regardless of surgical technique and curve correction, SF significantly improves patient perception of breast/chest wall symmetry.

Level of Evidence: 3

Outcomes of Revision Hip and Knee Arthroplasty in Children

Abstract ID: Paper 166

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INTRODUCTION: In the pediatric population, hip and knee arthroplasty are reserved for oncologic reconstruction or developmental abnormality with severe arthritis and pain. The outcomes of revision arthroplasty in the pediatric population have not previously been reported. The purpose of this study was to review and compare the outcomes of revision arthroplasty in pediatric patients with oncologic vs. developmental etiologies with a focus on (1) reason for index revision, (2) complications, and (3) clinical outcomes.

METHODS: We performed a retrospective cohort analysis of 6 revision TKAs and 17 revision THAs performed in pediatric patients over a 40-year period (1971-2011) at our institution. The initial underlying diagnosis was oncologic in 12 (52%) patients and developmental in 11 (48%). Oncologic patients were 42% female with a mean age of 14.9 (range 9-17) years and 5.4 year follow-up, whereas developmental patients were 55% female with a mean age of 15.7 (range 14-17) years and 8.8 year follow-up. Medical records were reviewed for all patients to capture demographic, disease, operative, and clinical outcome data.

RESULTS: The most common reason for initial revision was aseptic loosening in both groups. Kaplan-Meier survival free of complication, reoperation, and subsequent revision were similar between groups at 1, 5, and 10 years. An oncologic diagnosis did not increase the risk of complication (HR 1.4 [0.5-3.7], p=0.52), reoperation (HR 1.4 [0.5-3.7], p=0.52), or subsequent revision (HR 0.9 [0.3-3.0], p=0.93). Harris Hip Scores were similar between groups preoperatively, but were better in the developmental group at 2, 5, and 10 years ($p<0.05$).

CONCLUSIONS: Aseptic loosening is the most common indication for revision hip and knee arthroplasty in pediatric patients. There is a similarly high rate of complication, reoperation, and revision when comparing patients with oncologic and developmental etiologies. However, clinical outcomes are generally less favorable in those with an underlying oncologic diagnosis.

Patellar Sleeve Fractures: Nonoperative Management of Minimally-Displaced Fractures Provides Excellent Clinical and Functional Outcomes

Abstract ID: Paper 167

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BACKGROUND: Patellar sleeve fractures are rare, and typically result from a rapid contraction of the quadriceps with a flexed knee. These fractures often occur during athletics or other high acceleration activities. It has been suggested that these injuries should be managed operatively with prompt reduction and internal fixation. However, to date, there is sparse data regarding the management and outcomes of these fractures. The purpose of this study is to determine the outcomes of patients treated nonoperatively for minimally displaced patellar sleeve fractures.

METHODS: The records of all patients who presented with a radiographically confirmed patellar sleeve fracture between 1991 and 2014 were reviewed. All patients treated non-operatively for a documented traumatic patellar sleeve fracture without significant previous ipsilateral knee injury were included. Radiographs were reviewed for initial fracture displacement, patellar height using the Caton-Deschamps ratio, and presence of patellar tendon ossification. Outcomes were assessed using the Tegner Activity Scale, Kujala Score, and the International Knee Documentation Committee (IKDC) subjective knee evaluation score at final follow-up. Healing was defined as evidence of fracture union on radiographs.

RESULTS: Of the 18 patellar sleeve fracture identified, all consisted of an inferior pole avulsion. There were 18 males and no females with a mean age of 12 years (range, 9 to 18). Mechanism of injury included athletics (13; Table 1), fall (3), sledding (1), and collision (1). The average displacement was 1.1 mm (range, 0-3 mm). Final radiographic evaluation revealed fracture healing in all patients. Average final knee ROM was 0°-138°. No patient had evidence of an extensor lag. All 18 patients returned to full activity including sports activity. No patient required surgery. One patient had patellar tendon ossification at follow-up. Mean IKDC score was 96.4 ± 5.7. Mean Tegner Activity score was 6.7 ± 1.0, and mean Kujala score was 92.1 ± 11.9. Neither fracture displacement nor Caton-Deschamps ratio correlated with any of the above functional outcome scores.

CONCLUSIONS: Minimally displaced patellar sleeve fractures can be successfully managed non-operatively with excellent outcome scores and low risk of patellar tendon ossification.

Click here to view Table

Long-Term Evaluation of Tendon Transfers for Equinovarus Foot Deformity in Cerebral Palsy

Abstract ID: Paper 168

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INTRODUCTION: Cerebral palsy (CP) commonly presents with spastic equinovarus foot deformity, which is frequently managed with tendon transfers using either anterior or posterior tibial tendons. We retrospectively examined a consecutive series of patients with long term follow-up to evaluate the clinical outcomes of tendon transfers of the foot to determine factors associated with successful treatment and common reasons for reoperation.

METHODS: The clinical outcomes of 33 consecutive CP patients with the diagnosis of an equinovarus foot deformity treated at an average age of 11 years old with SPLATT, SPOTT, or both were retrospectively reviewed. Clinical outcomes were documented using postoperative grading of the hindfoot deformity and Kling & Kauffer's previously established clinical criteria based on the ability to obtain a foot position within 5° of neutral and types of shoe wear. Statistical analysis between the types of tendon transfers was performed using Chi-Square testing.

RESULTS: Treatment of subjects included 21 SPOTT, 9 SPLATT, and 3 combined tendon transfers with a 7.7 year average duration of follow-up. Overall, 12 patients (36%) required further surgical intervention and were, therefore, rated as a poor result. On average, patients failed the initial tendon transfer after 4.8 years with only two patients failing within 2 years of the index procedure. Among the poor outcomes, 5 patients had a SPOTT and 4 patients had a SPLATT, while all three patients with a combined tendon transfer failed into valgus ($p=0.03$). The most common reason for failure necessitating reoperation was overcorrection, which occurred 67% time, and was treated with re-transferring the tendon(s) and occasional subtalar stabilization. Recurrent equinovarus feet were treated with revision lengthenings and tendon transfers. All patients with a poor outcome successfully achieved a foot position within 5° of neutral after a second surgery.

DISCUSSION: Treatment of equinovarus foot deformity in CP with SPLATT or SPOTT demonstrates no difference in rates of clinical failure with long-term follow-up. Utilization of both combined SPLATT and SPOTT or SPLATT with posterior tibialis and achilles lengthening were always associated with failure into valgus. However, an isolated SPLATT always had a good or excellent outcome. Given early good results and the average duration to failure of 4.8 years, patients should continue to be followed clinically and observed for potential failure. Despite the consistent failure with a single-staged combined tendon transfer, a two-staged combined transfer provides a successful method for treating a recurrent equinovarus foot deformity.

Long-Term Outcome of Total Hip Arthroplasty in Patients With Cerebral Palsy: A Matched Cohort Study

Abstract ID: Paper 169

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INTRODUCTION: The spasticity and increased muscle tone that is a commonly observed in patients with cerebral palsy (CP) can lead to hip degeneration, subluxation and pain. Total hip arthroplasty (THA) has been used to provide pain relief in patients with CP; however, there is still hesitation to employ this effective technique. The purpose of this study was to review the outcome of total hip arthroplasty performed at our institution in patients with CP with a focus on need for revision, reoperation, and postoperative complications compared to a group of patients with a diagnosis of primary osteoarthritis (OA).

METHODS: We used an institutional total joint registry database and reviewed the medical records of 41,349 patients undergoing a primary THA over a 43-year period. Of these 35 (0.08%), THAs were performed in patients with a diagnosis of CP. The cohort was made up of 64% males, with a mean age and BMI of 52 years and 25.3 kg/m^2. The most common Gross Motor Function Classification Scale (GMFCS) level was 2 (n=16) and all patients could walk with assistance prior to surgery. Harris Hip Scores (HSS) were calculated prior to surgery and at the patients last follow-up. The mean follow-up was 7 years (up to 25 years). These patients were matched 1:2 to a group of patients undergoing THA for OA over the same time period. All patients were the same gender, age, and had their surgery within 2 years of the same surgical year. Kaplan-Meier survival and Cox Hazard Analysis was used to compare groups.

RESULTS: The mean implant survival for primary THA in patients with CP at the 10- and 25-year time points was 81%. There was no difference (HR 0.72, P=0.56) in implant survival, reoperation (HR 0.84, P=0.75), or postoperative complications (HR 0.55, P=0.12) compared to patients with a diagnosis of OA. There was no difference (P=0.77) in implant survival based on the patients GMFCS. Specifically, there was no increased risk of dislocation in patients with CP (OR 0.31, P=0.41). Prior to surgery, all patients had severe or moderate pain, this was significantly reduced (P <0.0001) postoperatively. The mean preoperative HSS was 37 and significantly improved (P=0.0001) to 77.

CONCLUSION: THA provides patients with CP significant pain relief and functional improvement. Patients with CP should expect similar outcome to those with a primary diagnosis of OA, and a diagnosis of CP should not discourage a surgeon from performing this procedure.

The Annular Ligament - Revisited

Abstract ID: Paper 170

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INTRODUCTION: There is conflicting information about the exact anatomy and nomenclature of the parts of the annular ligament. We used cadaver elbow dissections to define the anatomy and clarify terminology applied to the annular ligament.

METHODS: Dissections were performed on 12 embalmed cadaver elbows and 8 fresh frozen cadaver elbows. Once target ligaments were visualized and identified with palpation, they were marked with suture needles delineating their dimensions. Digital photographs were taken of each and then uploaded on our institution's radiology system in order to measure each ligament's dimensions in a standardized fashion. Two independent observers each conducted 2 sets of measurements 2 weeks apart, and intra-rater and inter-rater reliability was calculated.

RESULTS: The ligaments of the elbow were noted to be in two layers, a superficial layer consisting of the lateral ulnar collateral ligament (LUCL) and radial collateral ligament (RCL), and a deeper layer consisting of the annular ligament proper, and superior, inferior, and newly described anterior oblique ligaments of the annular ligament. We observed that the inferior oblique ligament (IOL) was a separate structure not formed by part of accessory LCL as previously postulated. The average width of annular ligament anteriorly was 8.9 mm, and posteriorly was 9.8 mm. The IOL was identified in all elbows, with an average width of 3.1 mm and average length of 11.7 mm. The superior oblique ligament (SOL) of the annular ligament was identified in 16 of 20 elbows, with an average width of 3.9 mm and average length of 11.5 mm. We also observed an anterior oblique ligament (AOL) in 9 of 20 elbows, with an average width of 4.3 mm, running distal to the anterior portion of the annular ligament and inserting on the coronoid process. The intra/inter observer reliabilities of the measurements were good to excellent.

CONCLUSION: The anatomy on the lateral side of the elbow is complex, and not well defined. The inferior oblique ligament can be found in all specimens, is located deeper to the lateral ulnar collateral ligament and inserts medial to supinator crest on the anterior surface of the ulna. SOL and AOL are not as consistent as IOL. The proportional sizes of these ligaments compared to annular ligament are quite substantial. Therefore, thorough knowledge of the anatomy might enhance our understanding of their role in the clinical problems of the elbow.

Surgical Dislocation of the Hip in Children and Adolescents

Abstract ID: Paper 171

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INTRODUCTION: Surgical hip dislocation is a versatile procedure that provides excellent exposure for treating a variety of pediatric and adolescent hip disorders. It is traditionally performed via a lateral approach with greater trochanteric osteotomy. The purpose of this study was to analyze our institution's experience with surgical hip dislocation.

MATERIALS/METHODS: A retrospective review was conducted of surgical hip dislocations performed on pediatric patients (≤ 18 years old) from 2000-2015. Clinical charts and radiographs were analyzed. Demographic information, indication, approach, procedures performed, complications, reoperations, and clinical and radiographic outcome measures were recorded.

RESULTS: 49 patients (57 hips) with a mean age of 14.9 (R 3-18) years old were reviewed, including 27 males and 22 females. Mean clinical follow-up was 25.7 months (R 3.5 – 124.5). Surgical indications included: FAI (n=17), FAI due to dysplasia (n=11), benign osseous lesions (n=9), avascular necrosis (n=4), acute trauma (n=3), Perthes deformity (n=3), PVNS (n=3), chronic SCFE (n=3), acute SCFE (n=2), and other (n=2). Exposure for 7 cases, mean age 11 years (R 3-16), was obtained without a greater trochanteric osteotomy. At follow-up, mean hip flexion and internal rotation improved significantly ($p<0.05$), as did pain scores ($p=0.0001$) and Harris Hip Score ($p=0.004$). There were 23 reoperations (40%), including 16 trochanteric screw removals (28%), 2 osteotomies, 2 revisions for benign lesion recurrence, 1 excision of acetabular hypertrophy, 1 intra-articular screw removal, and 1 conversion to THA for protrusio. Female gender was the only statistically significant risk factor for reoperation ($p=0.001$). Obesity ($p=0.09$) and trochanteric osteotomy ($p=0.75$) were trends that did not reach statistical significance. Other complications included 1 DVT and 2 cases of delayed trochanteric osteotomy healing. There was 1 new radiographic finding of AVN in an asymptomatic patient who had a femoral head fracture, and radiographic evidence of mild heterotopic ossification in 7 asymptomatic patients.

DISCUSSION: This retrospective review is the largest reported series of surgical hip dislocations in pediatric patients. While it is safe with relatively few complications, there is a high rate of lateral hip pain prompting reoperation for trochanteric screw removal (28%). The authors propose a modification to the Ganz technique in skeletally immature patients to avoid osteotomy of the greater trochanter. The 7 patients with this modification showed equivalent surgical exposure and outcomes, with immediate weight bearing and quicker return to activity. This exposure avoids risks associated with trochanteric osteotomy, including delayed/nonunion or lateral hip pain prompting screw removal.

Risk Factors for Surgical Release in Children With Clubfoot Treated by the Ponseti Method: Utility of Radiographic Assessment

Abstract ID: Paper 172

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BACKGROUND: The Ponseti method has become the gold standard for treatment of congenital talipes equinovarus (CTEV). Despite the success of initial deformity correction with the Ponseti method, the deformity recurs in some feet and may require more extensive surgical intervention. The primary goals of our study were to identify factors that may predispose patients to failure of correction with the Ponseti method and to determine the role of clinical scoring systems in predicting the need for surgical intervention.

METHODS: Seventy-eight patients with CTEV presented to a single institute between January of 2010 and January of 2013 and were enrolled in the IRB-approved prospective study; 64 patients (97 feet) met inclusion and exclusion criteria. Database information included demographic data and treatment details; Dimeglio and Pirani scores and radiographic results at presentation, 6 months, and 12 months; and deformity recurrence and the need for more extensive surgical release.

RESULTS: At an average follow-up of 32.4 months (range 18 to 60 months), 21 patients (33 feet, 34%) had required surgical release and represent the Ponseti failure (PF) cohort. These patients were compared to the cohort of 47 patients (64 feet) who did not require surgical correction for residual or recurrent clubfoot and who represent the successful Ponseti management (SPM) cohort. The differences between the Dimeglio and Pirani clinical scores in the two groups were statistically significantly different at all time points (presentation, 6 months, and 12 months). Risk factors found to correlate with surgical failure included higher presenting Dimeglio and Pirani scores, higher number of casts needed to correct the initial clubfoot deformity, and the need for repeat casting.

CONCLUSION: Children with CTEV who are at risk for failure of correction with the Ponseti method have significantly higher initial Pirani and Dimeglio scores, require more casts at initial treatment, and require more frequent recasting. Clinical scores at presentation, 6 months, and 12 months have moderate correlation to Ponseti Failure.

Risk Factors for Complications and Readmission After Operative Fixation of Pediatric Femur Fractures

Abstract ID: Paper 173

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INTRODUCTION: Over the past few decades, operative fixation of pediatric femur fractures with intramedullary implants has grown in popularity. However, risk factors for short-term adverse events and readmission have not been well studied.

METHODS: Pediatric patients who underwent intramedullary nailing of a femur fracture between 2012 and 2013 were identified from the American College of Surgeons National Surgical Quality Improvement Program database. Risk factors for any adverse event (AAE) and readmission after intramedullary nailing were evaluated using univariate and multivariate analysis.

RESULTS: A total of 522 pediatric patients who underwent intramedullary nailing of the femur were identified. The mean age in this cohort was 10.2 +/- 3.8 years. A total of 18 (3.4%) patients had AAE, while 20 (3.8%) patients were readmitted and 13 (2.5%) underwent a reoperation. Independent risk factors for AAE were a cardiac comorbidity (odds ratio [OR], 12.7), open fracture (OR, 10.2), and prolonged operative time (OR, 17.5). Independent risk factors for readmission were a central nervous system disorder (OR, 4.5) and a seizure disorder (OR, 4.9).

CONCLUSIONS: Multivariate analysis suggests that cardiac comorbidities, open fractures, and prolonged operative time increase the risk for AAE. Furthermore, central nervous system disorders and seizure disorders may increase the risk for readmission. Surgeons should be aware of these risk factors and counsel the families of pediatric patients who undergo intramedullary nailing of femur fractures.

A Multicenter Prospective Assessment of the Value of Work Done by an Orthopedic Resident During Call

Abstract ID: Paper 174

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OBJECTIVE: To quantify the amount of work that a first call orthopedic surgery residents (PGY2 and PGY3) performed while on call over a 90-day period at four Level 1 Trauma Centers, and compare that to Medicare DME funding received by the hospital for orthopedic residents.

METHODS: Four institutions prospectively collected orthopedic resident's on-call consults over a 90-day period. The patient's charts were retrospectively reviewed for demographics, admission data, orthopedic injuries, and procedures performed by the resident. Coding of patient diagnoses (ICD-9), evaluation and management (E&M), and procedural treatment performed in the ED (CPT) was performed. The CPT codes were then converted into work Relative Value Units (wRVUs) using the 2014 Medicare CPT to wRVU Crosswalk. Only procedures performed by the resident without attending supervision were used to calculate procedural CPT values. The number of wRVUs was multiplied by the 2014 Medicare rate of $35.8228/rvu to calculate the monetary value of resident work on call.

RESULTS: Of the 360 resident call shifts, 356 were available for review (98.8%). There were a total of 2692 patient consults. There were an average of 7.47 consults per night per institution. The total number of E&M codes generated 5633.21 wRVUs with a calculated dollar amount of $201,797.36. Procedural codes generated 6073.03 wRVUs with a calculated dollar amount of $217,552.94. There were a total of 11706.24wRVUs generated over the 360 call nights (32.52 RVUs per night). The total dollar amount generated was $419,350.29($1164.86 per call). An average annual dollar value of resident call work per institution using Medicare rates was $425,173.90.

DISCUSSION: National Medicare budgetary concerns threaten GME funding, which is provided in two forms: Direct Medical Education (DME) payments help cover the direct cost of GME such as stipends and benefits for residents; and Indirect Medical Education (IME) payments cover expenses associated with treatment of severely ill patients and the additional costs related to teaching residents. Our institution estimates Medicare DME support per resident at approximately $40,000 per year, with total funding of $130,000 per resident. Residency education necessarily occurs while residents are doing clinical work providing care for patients. This study only examines the work contributed by resident on nights and weekends when on call, and does not include work done during the week. Our data supports the level of Medicare funding received, as the value of on call work is significantly higher than the DME money paid hospitals for orthopedic residents.

Immediate Sarmiento Bracing for the Treatment of Humeral Shaft Fractures

Abstract ID: Paper 175

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INTRODUCTION: Coaptation splints require skillful application, are difficult to maintain, and are prone to skin complications. Our study evaluates if immediate application of a Sarmiento fracture brace produces equivalent radiographic alignment when compared with coaptation splinting.

METHODS: Using a retrospective cohort design, 51 patients were identified via CPT code and review of radiographs between January 2008 and March of 2015. Demographic data, patient factors including BMI, and associated nerve palsies were recorded. Orthogonal radiographs at the time of injury, postreduction, and where available, at union were measured for sagittal and coronal plane angulation. Initial immobilization was selected by staff preference and 20 patients were placed in fracture braces and 31 in coaptation splints. Acceptable alignment was considered to be <30° of varus angulation, <20° of sagittal plane angulation, and <2 cm shortening.

RESULTS: Of the 20 patients with immediate Sarmiento bracing, the average varus alignment after brace application was 8.0° vs. 9.6° for those with immediate coaptation splinting. The percentage of patients with acceptable alignment after reduction was 84% in both groups. Of patients with complete radiographs at union, all in the Sarmiento group healed in acceptable alignment as compared to 92% in the coaptation group. Patients in both groups were similar with regards to initial injury displacement, radial nerve palsy, and loss to follow-up. In the Sarmiento group, similar proportions of patients were lost to follow-up or converted to operative fixation. Five patients in the coaptation group required repeat reductions as compared to one in the Sarmiento group. All nonunions were in the coaptation splinting group.

DISCUSSION AND CONCLUSION: Postreduction alignment was similar following immediate application of the Sarmiento brace as compared with coaptation splinting. Equivalent proportions of patients had acceptable postreduction alignment and were less likely to undergo a repeat reduction. Given the difficult nature of coaptation splinting, these findings support immediate Sarmiento bracing for humeral shaft fractures.

Wide Variation of Surgical Cost Between Six Fellowship-Trained Trauma Surgeons in the Treatment of Periarticular Lower Extremity Injuries

Abstract ID: Paper 176

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INTRODUCTION: Improving health care value is important in today's economic environment. Procedural variation among surgeons may be a significant contributor to costs. We hypothesize that there would be a high variation in surgical cost between 6 surgeons in the treatment of bimalleolar ankle and bicondylar tibial plateau fractures, and also that certain high-cost items would be identified as potentials for cost savings in the future.

METHODS: We developed a tool called a "seismograph," which allows analysis of detailed costs of surgical procedures. We isolated bimalleolar ankle fractures and bicondylar tibial plateau fracture cases from a single Level 1 trauma center over a two-year period using a CPT code search. We excluded cases with multiple procedures in one setting. All procedural costs were captured by the seismograph. The seismograph provided a bird's eye view of all charges, which highlighted patterns. We analyzed the data and compared mean costs between 6 surgeons using one-way Analysis of Variance.

RESULTS: Total surgical cost for 88 bimalleolar ankle fractures was $96,866 and $146,066 for 46 bicondylar tibial plateau fractures. The mean cost for treatment of a bimalleolar ankle fracture was $1099, widely ranging from $613 to $2243 (p=0.009). The median cost, however, had a tight range of $598 to $784, indicating that the most expensive cases significantly contributed to the total cost. The most expensive 25% of cases resulted in 57% of the overall cost of all bimalleolar ankle fractures. The mean cost for treatment of a bicondylar tibial plateau fracture was $3219, ranging from $1839 to $4088 (p=0.064). The median cost range was wider, from $1826 to $3989, indicating a broad range of treatment patterns between surgeons. High-price items that substantially increased cost were synthetic bone void fillers, allograft, adjunctive (whether temporary or permanent) external and internal fixation, locking plates, and disposable and single-use items such as taps, guide wires, etc.

CONCLUSIONS: This study demonstrated a wide variation in direct surgical cost in the treatment of bimalleolar ankle fractures and bicondylar tibial plateau fractures between 6 surgeons at the same Level 1 trauma center. We identified high priced items, some of which can be easily avoided, and some of which should be evaluated for their contribution to patient outcomes in future clinical studies. The use of the "seismograph" bears an enormous potential for cost savings as it can be used to critically analyze the cost of other surgical procedures within and outside of orthopedics.

Adverse Events, Readmission Rates, and Unplanned Access to Care Following Outpatient Total Joint Arthroplasty

Abstract ID: Paper 177

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INTRODUCTION: Advances and improvements in total joint arthroplasty (TJA) and TJA pain management have resulted in decreased length of stay, and subsequently the development of outpatient TJA protocols. In March of 2014, a de novo ambulatory surgery center began to perform outpatient TJAs.

Unplanned access to healthcare and adverse events within the 30-day postoperative period were collected from 432 outpatients between 3/18/2014 and 4/16/2015. This study reports rates of early access and adverse events and factors that affect rate of unplanned access to care or adverse events.

METHODS: Between 3/18/2014 and 4/16/2015, 432 patients underwent outpatient THA (n=177) or TKA (n=255) at a de novo outpatient facility. Patient-reported complications were collected at least 30 days postoperatively. Patients completed a six-question survey regarding unplanned access of care, hospital readmission, and prescription antibiotic use. Unplanned access to care included ED visits, hospital readmission, early return to surgical care team, primary care physician visits, and visits to an orthopedic urgent care facility. Adverse events included hospital readmission and complications requiring prescription antibiotics and/or change of care plan.

RESULTS: Twelve adverse events were reported. Five patients required hospital readmission. The hospital readmission rate was 1.2% (5/432). There were three THA hospital readmissions due to dislocation (n=1), pneumonia (n=1), and infection (n=1). There were two TKA hospital readmissions due to swelling with pain (n=1) and hematoma (n=1).

Forty-seven patients reported unplanned postoperative access (rate 10.9%, 47/432).

There was a significant difference in unplanned access between surgeries performed 3/18/2014-12/31/2014 and those performed 1/1/2015-4/16/2015 (13.9% vs. 4.4%, $p<.01$). Age and surgeon did not affect the rate of unplanned access nor readmission.

CONCLUSION: As outpatient TJA procedures become more common, adverse events and unplanned access to care should be reported for quality improvement and achievement of the triple aim goals. This data supports the implementation of outpatient TJA pathways in the ambulatory surgery center setting.

Evaluating Internal Fixation Skills Using Surgical Simulation

Abstract ID: Paper 178

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INTRODUCTION: Open reduction and internal fixation (ORIF) is a basic and critical skill for an orthopedic surgeon, yet teaching this skill to surgical residents poses complications in both complexity and cost. Surgical simulation as an alternative to cadaveric practice has demonstrated efficacy as an important teaching tool, but the techniques and resources required for effective simulation vary greatly. We hypothesized that simulation of the technical components involved in ORIF could be accomplished in a cost-effective and reproducible manner, and that experience with the simulation coupled with didactic learning would lead to an increase in the residents' ORIF skill proficiency.

METHODS: Eight PGY1 orthopedic surgery interns attended a module designed to introduce and practice internal fixation techniques. The skills assessed included Drilling Accuracy, Plunge-Control, and Fixation Construct Strength. Drilling Accuracy was simulated and assessed with angled drilling through PVC cylinders and bisection of wooden dowels to model bone geometry and challenge tool manipulation. Plunge-control was simulated and assessed with layered boards of varying densities to model the non-uniformity of bone. Fixation Construct Strength was simulated by reducing and fixing oblique fractures on biomechanical-grade Ulna Sawbones and assessed by loading them to failure under four-point bending to determine construct strength and stiffness. Each simulation method was given a pre-defined metric, and the interns were assessed before an educational module and one-week after the educational module. Furthermore, the drilling and plunge-control techniques were assessed three months following the module. The metrics set forth for the PVC angled-drilling exercise, wooden dowel bisection, and plunge-control layered boards were assessed using a Repeated Measures ANOVA, and the construct strength of the ulna fracture fixation was compared using a paired t-test.

RESULTS: Significant improvement was observed in all residents for each parameter. Post-hoc testing revealed that pre-module to post-module improvements were all statistically significant, and no change was observed between their post-module performances and their three-month follow-up performances in the angled drilling, bisection, and one of the two plunge-avoidance tasks. The interns also achieved significantly greater strengths in their ulnar fixation constructs, with an average improvement of 367 N ($p=0.004$) from pre- to post-module.

CONCLUSIONS: These results indicate significant performance improvements in each of the 8 interns' competency with technical skills relevant to internal fixation techniques after their exposure to faculty-led lecture and hands-on skills practice. The effectiveness of these techniques demonstrates an accessible, easily-replicable, and efficacious means of adding ORIF skill simulation to resident education.

The Impact of Risk Reduction Protocols on 30-Day Readmission After Primary Hip or Knee Arthroplasty

Abstract ID: Paper 179

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INTRODUCTION: We performed this study to determine whether initiatives to decrease surgical complications were effective in reducing 30-day readmission risk following total hip arthroplasty (THA) and total knee arthroplasty (TKA).

METHODS: After obtaining IRB approval, we retrospectively identified 156 THA (3.8%) and 138 TKA (4.1%) 30-day readmissions from 4,131 THA and 3,372 THA procedures (2006-2013). The cohorts were subdivided into two groups relative to service-wide protocol changes initiated in 2010. Thirty-day readmission, blood transfusion, and skilled nursing facility discharge rates were compared across the two intervals using univariate analysis. Multivariate stepwise logistic regression analysis was performed to assess the impact of patient demographics and perioperative interventions on 30-day readmission rates.

RESULTS: Thirty-day TKA readmission rates declined from 5.6% to 3.0% ($p<0.001$). A reduction in surgically-related complications (3.9% vs 1.7%) accounted for the greatest change in readmission risk. Thirty-day THA readmissions did not decrease (4.0% vs. 3.6%, $p=0.41$). VTE risk-stratification ($p<0.001$), lower transfusion thresholds ($p<0.001$), and tranexamic acid ($p=0.001$) were associated with lower 30-day hospital readmission rates. The strongest association of readmission risk occurred among patients with advanced medical disease states including liver failure (OR 5.8), peptic ulcer disease (OR 3.8), diabetes with end organ disease (OR 3.8), advanced kidney disease (OR 3.2), and congestive heart failure (OR 2.9). Patient demographic considerations that were most strongly associated with increased 30-day readmission risk included skilled nursing facility discharge (OR 3.3), Medicaid insurance status (OR 2.8), Medicare insurance status (OR 2.3), or African American minority status (OR 2.1). Service-wide clinical care protocol introduction was associated with a process that decreased the 30-day risk of hospital readmission following THA/TKA. The most substantial reductions were noted with diabetes management (OR 0.6), lowering transfusion thresholds (OR 0.7), administration of tranexamic acid (OR 0.8), and VTE risk stratification (OR 0.8).

CONCLUSIONS: Surgical complication rates and 30-day readmissions were reduced significantly after TKA, but not THA. Risk reduction models should consider differences in responses to treatment initiatives in addition to patient medical comorbidities when considering the potential to limit readmission risks among patients undergoing elective primary total hip and total knee arthroplasty.

Noninvasive Hemoglobin Monitoring: A Rapid, Reliable, and Cost-Effective Method Following Total Joint Replacement

Abstract ID: Paper 180

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INTRODUCTION: Noninvasive hemoglobin (nHgb) monitoring was initially introduced in the ICU setting as a means of rapidly assessing Hgb values without obtaining a blood draw. To date, this technology has not been validated in total joint arthroplasty (TJA) patients. We performed a prospective analysis to compare the reliability, cost, and patient preference of nHgb monitoring to invasive Hgb (iHgb) monitoring via a traditional blood draw.

METHODS: One hundred consecutive patients were enrolled following TJA. On postoperative day one, nHgb and iHgb were obtained within 30 minutes of one another. The Masimo Pronto 7 was used for all nHgb testing. iHgb and nHgb values, cost, patient satisfaction, and the time required to obtain each reading were recorded. Concordance and intraclass correlation coefficients (ICCs) were utilized to compare the relatedness of the two Hgb values. A Student's t-test was utilized to compare mean Hgb values, time, pain, and patient preference for all readings.

RESULTS: There was no significant difference in mean Hgb, the iHgb value was 11.3 g/dL (range, 8.2-14.3 g/dL) and the nHgb value was 11.5 g/dL (range, 7.0-16.0 g/dL) (p=0.37). The concordance correlation and ICCs between the two Hgb values were 0.69 each. Greater reliability was noted for nHgb readings ≥ 10.5 g/dL. 100% of patients with a nHgb of ≥10.5 g/dL had a iHgb value ≥8.0 g/dL. The mean time to obtain a Hgb value was 0.86 minutes for nHgb and 51.1 minutes for iHgb (p=0.0001). At our institution, the cost of iHgb was $28 per blood draw compared to $2 for each iHgb, resulting in a savings of $26 per blood draw. 88% of patients preferred the nHgb, 7% preferred iHgb, and 5% were uncertain.

DISCUSSION: Noninvasive Hgb monitoring was found to be more efficient, less expensive, and preferred by patients over iHgb. It was more accurate for measuring Hgb values ≥10.5 g/dL, but less accurate below this value. Providers could consider screening TJA patients with nHgb and only ordering iHgb if the nHgb is < 10.5 g/dL. If this protocol were applied to the first blood draw in these 100 patients, $2,000 would have been saved. Extrapolated to the U.S. TJA practice, $20 million could be saved annually.

MAOA BREAKOUT SESSION #13
KNEE ARTHROPLASTY
April 16, 2016

Contemporary UKA vs. HTO in 239 Patients Under 55: UKA Provided Higher Activity and Durability at 5-7 Years

Abstract ID: Paper 181

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PURPOSE: For treatment of medial compartment arthritis, high tibial osteotomy (HTO) may be more desirable for patients with a higher activity level compared to medial unicompartmental arthroplasty (UKA), but currently there is little data available. The purpose of this comparative study was to determine (1) the postoperative activity level and function and (2) survivorship free of revision to total knee arthroplasty (TKA) in similar patients undergoing these procedures. We hypothesized that patients treated with HTO would return to a higher activity level and have similar durability compared to patients treated with UKA.

METHODS: Between 1998 and 2013, 239 patients under age 55 with medial compartment arthritis were treated either with HTO (n=57) or UKA (n=182). The mean age of the patients in the HTO group was 42.7 (41M: 16F) compared to 49.2 (81M: 101F) in the UKA group. Patients were evaluated at baseline, 3 months, 1 year, 2 years, 5 years, and final follow-up using Tegner activity level and Lysholm knee scores. Survivorship was defined as no revision to TKA. A Wilcoxon signed rank sum test was used to evaluate the difference between Tegner and Lysholm scores both preoperatively and at each interval postoperatively for both groups.

RESULTS: The patients in each group had similar Tegner and Lysholm scores at baseline. Postoperatively, the UKA group had higher Tegner activity scores at 3 months ($p<0.01$), 2 years ($p<0.01$), and at final follow-up ($p<0.01$) compared to the HTO group. The UKA group also had superior Lysholm scores at 3 months ($p<0.01$) and final follow-up ($p<0.01$). Survivorship was 88.1% in the HTO group at an average of 7.1 years of follow-up and 97.3% in the UKA group at an average of 5.8 years of follow-up ($p=.003$).

CONCLUSION: In this comparative study of young patients with isolated unicompartmental arthritis, patients treated with UKA more quickly reached a higher level of function and activity level at 3 months compared to those treated with HTO. Unexpectedly, these higher levels of activity level and function persisted at mid-term follow-up, with increased durability and less revision to TKA in the UKA group.

SIGNIFICANCE: This result challenges the conventional perception that young patients regain higher activity level with HTO for unicompartmental knee arthritis when compared to patients treated with UKA.

Safety and Cost-Effectiveness of Outpatient Unicompartmental Knee Arthroplasty in the Ambulatory Surgery Center: A Matched Cohort Study

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BACKGROUND: Unicompartmental knee arthroplasty (UKA) has an established track record for pain relief and improved function in patients with unicompartmental osteoarthritis of the knee. Historically, UKA was performed in the inpatient hospital setting. However, with renewed emphasis on procedural safety, efficiency, and cost effectiveness in the healthcare industry, many surgeons and patients are finding the ambulatory surgery center (ASC) to be a viable option for arthroplasty procedures. We proposed to compare a matched cohort of outpatient ASC UKA's with those performed in the inpatient hospital setting to evaluate episode-of-care complications. We also proposed to investigate our ASC UKA total facility charges.

METHODS: Sixty-seven patients underwent UKA performed by one of two surgeons at a freestanding ASC. An age and co-morbidities-matched cohort included 48 patients undergoing UKA in the standard inpatient hospital setting. Ninety day episode-of-care measures included complications, hospital (re)admissions, and reoperations. Total facility charges were evaluated for all ASC patients. Statistical differences ($p<0.05$) between the ASC and inpatient groups were determined by two-tailed t-tests.

RESULTS: The ASC and hospital cohorts revealed no statistically significant differences with respect to age (58.8 vs. 59.4), sex (15M/33F vs. 20M/28F), BMI (34.3 vs. 32.9), and preoperative ASA scores (1.94 vs. 2.08). Two minor complications were noted in the ASC group including one superficial stitch abscess and one superficial rash surrounding a surgical incision. There were no major complications in the ASC group, and no patients required hospital admission or reoperation. In the hospital cohort there were no minor complications. However, four major complications were noted: one deep venous thrombosis (DVT), one pulmonary embolus (PE), one acute postoperative infection, and one postoperative periprosthetic fracture. All four of the hospital cohort patients with complications required readmission, while two of the hospital cohort patients required reoperation. The average total charge for all ASC patients was $29,475.14.

DISCUSSION: These results demonstrate that outpatient UKA in the ASC is a safe and reasonable alternative to UKA performed in the traditional inpatient hospital setting. Additionally, the average total charge for UKA in the ASC compares favorably to reported inpatient total charges for UKA and total knee arthroplasty in the literature. Despite our favorable short-term results with UKA in the ASC, further investigation is required to address the long-term safety and cost-effectiveness of UKA performed in the ASC setting.

Patient-Reported Allergies: Do the Numbers Affect Outcomes Following Primary Total Hip and Knee Arthroplasty?

Abstract ID: Paper 184

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INTRODUCTION: Patient report dissatisfaction rates following elective TKA and THA range from 14 to 28%. Government organizations and insurers are considering payments based on patient reported satisfaction. The authors have previously retrospectively reported higher rates of dissatisfaction following TKR and THR in patients with multiple allergies. The purpose of this study was to prospectively compare patient reported outcomes in patients with and without multiple reported allergies.

METHODS: We prospectively evaluated 500 THA/TKA patients at a single institution in 2013 who completed the Short Form-36 (SF-36) and a questionnaire including demographics, allergies, and comorbidities. The Charleston Comorbidity Index, SF-36, and WOMAC were calculated at minimum 1-year follow-up. Appropriate statistical analysis was used to determine differences in parametric (sex, THA/TKA) and continuous (age, comorbidity score, and number of allergies) variables, and to calculate independent effects of the variables on patient-reported outcomes.

RESULTS: Minimum follow-up was 1 year. SF-36 PCS and MCS increased postoperatively. Males had significantly higher postoperative SF-36 PCS and WOMAC scores ($p<0.0001$). Comorbidity index had a significant negative correlation with postoperative SF-36 PCS ($r=-0.3$, $p=0.001$) and postoperative SF-36 MCS ($r=-0.3$, $p=0.005$). Number of patient reported allergies had a significant negative association with preoperative SF-36 PCS, as well as postoperative SF-36 PCS, MCS, and WOMAC independent of age and comorbidity index ($p<0.03$).

CONCLUSION: Patients with multiple reported allergies who undergo THR and TKR report less improvement in SF36 physical components scores and WOMAC functional scores following the procedure, independent of age and patient-reported comorbidities. This patient subgroup with multiple allergies should be counseled as to the potential for less satisfactory outcomes than the patients without multiple allergies. This represents an important process in outcomes studies where authors study a problem retrospectively and then implement a prospective study to corroborate the findings of the retrospective study.

What is the Benefit of Staphylococcal Screening and Treatment Prior to Elective Hip/Knee Arthroplasty?

Abstract ID: Paper 185

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INTRODUCTION: Deep infection following elective total joint arthroplasty is a devastating complication. Preoperative nasal screening for Staphylococcus aureus colonization and subsequent treatment of colonized patients is one proposed method to identify at-risk patients and decrease surgical site infections (SSI). The purpose of this study was to determine (1) if a preoperative Staphylococcal screening and treatment program would decrease the incidence of SSI in elective joint replacement patients and (2) if non-Staphylococcal infections would become more prominent among those patients who developed a SSI.

METHODS: Beginning in January 2009, all patients having an elective joint replacement were screened prior to surgery for methicillin-resistant Staphylococcus aureus (MRSA) and methicillin-sensitive Staphylococcus aureus (MSSA) with nares swabbing. All patients with positive nares colonization for MSSA or MRSA were treated with mupirocin and chlorhexidine gluconate (CHG) showers for five days prior to surgery. All patients scheduled for elective joint replacement used CHG antiseptic cloths the evening prior to and the day of surgery. Perioperative infection rates were compared one year prior to five years post-implementation.

RESULTS: 13,717 patients (4962 hips, 8755 knees) underwent primary joint replacement between January 2008 and December 2014. The SSI rates have decreased from 0.89% (pre-screening) to 0.27% (nasal screening) ($p<0.05$) following initiation of the decolonization protocol. Staphylococcal species represented 91.7% of the infecting organisms prior to the routine screening, whereas, Staphylococcal species only characterized 42.7% of the infecting organisms following screening and decolonization ($p<0.05$).

DISCUSSION/CONCLUSIONS: The addition of MRSA/MSSA nares screening preoperatively and bathing with CHG antiseptic cloths evening before and day of surgery has resulted in a decreased SSI rate by 70% following primary total hip and knee arthroplasty. Conversely, routine Staphylococcal screening and decolonization may result in a greater propensity to develop a non-Staphylococcal infection among those who develop a postoperative SSI.

Can We Predict Discharge Status After Total Joint Arthroplasty? A Simple Calculator to Predict Home Discharge

Abstract ID: Paper 186

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INTRODUCTION: Postoperative discharge to a skilled facility following TJA is associated with increased costs and complications. While regional variation in discharge disposition exists, we hypothesize that intrinsic patient characteristics heavily influence the probability of discharge status. Thus, the purpose of this study was to identify the risk factors for discharge to a skilled facility, quantify risk-factor impacts, and use them to build a predictive calculator.

METHODS: The NSQIP database was queried from 2009-2013 to identify patients who underwent primary THA/TKA. Patient demographics, comorbidties, and operative variables were identified and compared between those discharging home and not home. Univariate analysis and logistic regression models were employed to identify associations and predictors of discharge home. The predictor variables were weighted based on the Beta-coefficient from the logistic regression equation and converted to discrete values that were incorporated into a simple numerical calculator. Model discrimination was predictive with a c-index of 0.70.

RESULTS: 107,300 patients underwent TJA. 69.2% were discharged home, 30.8% to a facility. Patients discharged to facility were older, female, had higher aggregate comorbidities, and required some functional assistance before surgery ($p<0.001$ for all). The 30-day risk of mortality was 10 fold higher to a facility ($p<0.001$). The 30-day risk of any morbidity was 3 times higher (8.2% vs. 25.5%). Patient age, preoperative functional status and living location, non-elective surgery, and ASA Class were most predictive of discharge to a facility. Patients with higher risk calculator scores had greater chance of discharge to a facility (40 and 80 points indicated 75% and 99% probability, respectively, $p<0.001$).

CONCLUSIONS: 30% of patients were discharged to a facility following THA/TKA. Surgeons, and hospitals may use this simple calculator to start discharge planning before surgery. With the advent of peri-operative “bundled payments”, this data will also help policymakers build risk-adjustment models to allow fair resource distribution.

Distal Femur Rotational Alignment in Patient Specific Instrumentation: A CT-Based Evaluation

Abstract ID: Paper 187

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INTRODUCTION: Posterior condylar referencing, a common method for determining femoral axial orientation during total knee arthroplasty (TKA) surgery, relies upon an assumed consistent relationship between the posterior condylar line (PCL) and the transepicondylar axis (TEA) of 3°. In this study, we aim to examine the PCL-TEA relationship, identify frequency and magnitude of outliers, and assess interaction with other anthropometric measurements.

METHODS: 2912 CT scans for pre-surgical creation of custom instrumentation and 91 CT scans of non-diseased cadaveric knees were analyzed. Spearman correlation coefficient and multiple linear regressions were performed to assess interaction between PCL-TEA relation and other anthropometric measurements (hip-knee angle, tibial slope, proximal tibial angle, distal femoral angle, gender, and age). Sub-group analysis was performed of PCL-TEA outliers in the diseased cohort (greater or lesser than 3°±1°).

RESULTS: The mean (SD) difference between the PCL and TEA in the pathologic knees was 2.91 (0.77) and in 92.3% the PCL-TEA relationship was within 3° ± 1°. The mean (SD) difference between the PCL and TEA in the non-diseased knees was 3.04 (0.90) and in 92.3% the PCL-TEA relationship was within 3° ±1°. The PCL-TEA relationship was no different between groups ($p>0.05$). There was no significant interaction with age or gender and PCL-TEA relationship. Of the anthropometric variables, there was a significant interaction with increased tibial slope and increasing PCL-TEA angle ($p=0.0233$).

CONCLUSION: In the majority of knees, the PCL-TEA relationship is within 3° and supports the routine use of posterior condylar referencing instrumentation. However, increased tibial slope is associated with outlier PCL-TEA relationship and surgeons should consider alternative techniques to establish femoral axial rotation in these cases.

Fat Distribution is Predictive of Early Reoperation and Infection Following Primary TKA

Abstract ID: Paper 188

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BACKGROUND: Morbid obesity has been linked with worse outcomes following total knee arthroplasty (TKA), but little data is available for risk stratifying patients within this diverse population. Peri-incisional fat distribution has been proposed as a risk factor.

QUESTIONS/PURPOSES: The aims of this study were (1) to assess the inter- and intra-observable reliability of measuring anterior knee soft tissue thickness on routine lateral knee radiographs and (2) to compare anterior knee soft tissue thickness between morbidly obese patients who required early (≤ 90 day) reoperations with a matched cohort of morbidly obese patients who did not require early reoperation.

METHODS: Using a retrospective case-control analysis, we reviewed 1,689 primary TKAs performed in morbidly obese patients at our institution over a 17-year period (1995-2012). All patients (n=58) who required reoperation for wound complication or infection within 90 days were identified and compared to a cohort of morbidly obese patients who did not require early reoperation, matched 1:1 using sex, age (±3 years), date of surgery (±1 years), BMI (±1 kg/m^2), and diagnosis of diabetes mellitus. All patients had minimum 90-day follow-up. Distances from patella-skin (prepatellar thickness) and tibial tubercle-skin (pretubercular thickness) were measured on routine lateral knee radiographs by two authors and assessed using correlation and Cronbach-alpha coefficients.

RESULTS: We found excellent intra- and interobserver reliability in measuring prepatellar and pretubercular soft tissue thickness. Knees in the complication group had significantly greater prepatellar (17 mm vs. 10 mm, p=0.0001) and pretubercular (25 mm vs. 16 mm, p=0.0006) soft tissue thickness. Prepatellar thickness ≥15 mm and pretubercular thickness ≥25 mm increased the risk of early reoperation by 2.0X (p=0.0003) and 1.6X (p=0.023), respectively.

CONCLUSION: Anterior knee soft tissue thickness can be reproducibly measured on lateral knee radiographs and significantly increases the risk of early reoperation for wound complications and infection following primary TKA in morbidly obese patients.

Are Rates of Blood Utilization Decreasing Following Primary TKA? A Look at 2008-2014

Abstract ID: Paper 189

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INTRODUCTION: Blood preservation strategies have evolved greatly over the last five years to include lowering trigger points for transfusion, specific hydration protocols, and use of anti-fibrinolytics. In addition, transfusion rates are now being used as a quality indicator, especially in high volume procedures. There is a paucity of large database longitudinal blood utilization studies in TKA that include recently performed surgery. The purpose of this study was to utilize a large multicenter database to evaluate trends in blood transfusion rates following primary TKA, including 2014 data, and to compare comorbidities and 90-day complications between transfused and non-transfused cohorts.

METHODS: The Humana Inc. dataset was reviewed from years 2007-2014 for all patients undergoing primary TKA. Patients, comorbidities, and 90-day outcomes were identified using ICD-9 and CPT codes. Blood transfusion rates were calculated and trended by year for the dates included in the dataset. Patient demographics, comorbidities, and 90-day outcomes were compared between patients requiring and not requiring blood transfusion.

RESULTS: 1,805 (1.6%) patients required blood transfusion after TKA and 113,518 (98.4%) of patients did not. Transfusion rates decreased by 57.5% over the years for this dataset with a transfusion rate of 1.86% in 2007 and 0.79% in 2014. Patients that required transfusion following TKA had more medical comorbidities including higher Charlson Comorbidity Index and higher rates of PVD, CKD, CHF, and CAD ($p<0.0001$). For the transfusion group, major complication, minor complications, and infection were all significantly higher than for the non-transfused group ($p<0.0001$).

CONCLUSIONS: By 2007, transfusion rates had already been reduced to 1.9% following TKA. With blood management strategies instituted over the last 7 years, there has been a further 57.5% reduction in blood utilization following TKA. This is an especially important reduction when considering that patients requiring transfusions after TKA have more comorbidities and higher rates of postoperative complications.

Risk-Adjusted Outcomes of Total Knee Arthroplasty in Academic vs. Community Hospitals

Abstract ID: Paper 190

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INTRODUCTION: Despite a large portion of joint replacement operations being performed in community hospitals, the literature has sparsely evaluated outcomes in this setting. The goal of this study was to compare total knee arthroplasty (TKA) outcomes between academic and community hospitals.

METHODS: 409,719 TKA admissions were identified from the 2005-2011 New York and California State Inpatient Database Admissions that were unplanned or associated with a complication of previous arthroplasty, patients with history of lower extremity fracture, lower extremity bone malignancy, or age < 18 were excluded. Odds ratios (OR) > 1.0 occurred more frequently in academic hospitals, and those < 1.0 occurred more frequently in community hospitals.

RESULTS: There were 201,408 procedures done in academic hospitals and 208,311 procedures done in community hospitals. Overall mean Elixhauser score was 0.96±0.009 for academic and 0.97±0.008 for community hospitals ($p<0.001$). There was no statistically significant difference in risk for periprosthetic joint infection ($p=0.0674$). However, there was a greater risk of having any complication at an academic hospital (OR=1.134). The top five complications that were more likely to occur at an academic hospital were deep vein thrombosis (OR=2.615), pulmonary embolism (OR=1.928), peripheral vascular complication (OR=1.641), postoperative infection (OR=1.251), and cellulitis (OR=1.229). Complications that were more likely to occur at a community hospital were postoperative shock (OR=0.614), pulmonary insufficiency after surgery (OR=0.768), incision and debridement (OR=0.806), and respiratory complication (OR=0.868). Academic hospitals realized lower total cost per procedure while community hospitals had a lower mean LOS.

CONCLUSION: Results indicate that the complication risk profile varies for patients depending on the type of hospital in which the procedure is performed. Surgical variables which cannot be accounted for with these large databases may be confounders.

Patient Reported Outcomes: Inpatient vs. Outpatient Total Knee Arthroplasty

Abstract ID: Paper 191

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INTRODUCTION: Outpatient total joint arthroplasty (TJA) is emerging as a viable alternative to the historically accepted hospital-based inpatient TJA in the United States. Several studies have focused on the financial advantages of outpatient TJA; however, little research has discussed patient reported outcome measures (PROM) and the overall patient experience. The purpose of this study is to compare PROM data in patients undergoing outpatient vs. inpatient total knee arthroplasty (TKA) performed in the first year of a newly opened outpatient facility.

METHODS: An internal quality metric database analysis was performed on patients undergoing TKA between February 14, 2014, and May 1, 2015. Outpatient TKA was performed at an ambulatory surgery center. 343 TKA patients (inpatient and outpatient) between the ages of 37-65 years old were included. The Oxford Hip, VAS Pain, and Treatment Satisfaction Questionnaires were completed preoperatively, and at 3 and 6 months postoperatively.

Chi-squared analyses determined differences in percentages between outpatient and inpatient PROM. Independent samples t-tests determined significant improvements between preop and 6 month postop PROM scores.

RESULTS: Outpatients showed a significantly higher improvement in VAS pain score at 6 months compared to inpatients (74.5% vs. 61.6%, $p<0.01$).

Outpatients rated their pain relief as very good-to-excellent significantly higher than inpatients (90.0% vs. 74.0%, $p=.020$) at 6 months postop.

Outpatients rated their ability to perform regular activities as “very good-to-excellent” more frequently as inpatients (82.0% vs. 59.3%, $p=.004$) at 6 months postop. This difference was significant.

A significantly higher percentage of outpatients reported very good-to-excellent meeting of expectations compared to inpatients (82.0% vs. 63.4%, $p=.017$) at 6 months postop.

No statistical difference was found between outpatients and inpatients in terms of Oxford Knee (function) scores at 6 months postop.

No statistical differences between the inpatient and outpatient groups were noted at the 3 month postop time point.

CONCLUSION: Significantly greater improvement was reported by outpatient TKA patients vs. inpatient TKA patients at six months postop. Outpatients report a greater improvement on the

VAS Pain score, and report a higher frequency of top-box ratings on the TKA normal joint and TKA satisfaction questionnaires. The implementation of outpatient TKA procedures shows greater overall patient satisfaction and improvement 6 months post-operation. This study illustrates that a de novo outpatient TJA pathway and facility can be successfully implemented with very high levels of patient satisfaction and patient reported success.

Non-Elective Joint Arthroplasty is Associated With Increased Length of Stay and Alternative Discharge Disposition

Abstract ID: Paper 192

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INTRODUCTION: Alternative payment models such as episode-of-care and bundled payments attempt to reduce cost. The purpose of this study is to determine if “non-elective/complex” joint arthroplasty (CJA) patients are associated with a longer length of stay (LOS), a higher rate of discharge to locations other than home, and a higher re-admission rate.

METHODS: A retrospective review of all patients undergoing CJA in the DRG code 469/70 from 2013 – 2014 was performed. CPT codes indicating CJA included 27125 (hemiarthroplasty of hip), 27236 (open treatment of femoral neck fracture), 27132 (conversion of hemiarthroplasty or previous hip surgery to total hip arthroplasty), 20680 (removal of deep implant), and 27445 (fracture of distal femur requiring distal femoral replacement). A consecutive subset of 80 patients undergoing elective primary joint arthroplasty (EJA) from the same time period with the CPT codes 27130 (total hip arthroplasty) and 27447 (total knee arthroplasty) were analyzed. LOS, discharge disposition, and re-admission rate were compared between these two groups.

RESULTS: LOS was significantly longer for the CJA cohort (3.11 days) compared to the EJA (1.3 days). 40% of the CJA patients were discharged to a location other than home compared to 2.5% for the EJA. The readmission rate for the CJA group was 12.5% while the EJA group was 2.5%.

CONCLUSION: As alternative payment models are increasingly more common, it is important that surgeons and hospital institutions identify patients at risk as a cost outlier. We discovered patients with CJA-associated CPT codes have significantly longer LOS, greater rate of discharge to facility other than home, and a higher re-admission rate. These “non-elective/complex” episodes cost more than their counterparts. As payment schemes change, we must continue to develop a better understanding of the intricacies of these alternative models.

Preoperative and Discharge Predictive Tools for 30-Day Readmission Following Total Knee Arthroplasty

Abstract ID: Paper 193

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INTRODUCTION: Unplanned hospital readmission following surgery is a quality metric targeted by healthcare reform programs and now includes patients readmitted after elective total knee arthroplasty (TKA). Hospitals are being penalized for excessive readmissions after surgery via a reduction in the total amount of reimbursement payments. Multivariable clinical tools for predicting the likelihood of 30-day readmission after primary and revision TKA will help clinicians identify high-risk patients for readmission, both preoperatively and at discharge.

METHODS: A total of 319,936 primary TKA and 24,094 revision TKA admissions were identified using data from the New York and California State Inpatient Databases from 2007-2011. Several demographic variables (n=5) and comorbidities (n=30) were used to create a model to preoperatively predict a patient's probability of 30-day readmission. Additional inpatient data (n=7) in combination with the variables used for the preoperative model were used to create a model to predict the likelihood of readmission at discharge. The models were used to create risk calculators that can be administered preoperatively and at the time of discharge to determine the readmission likelihood for each patient.

RESULTS: Overall 30-day readmission rates were 4.1% for primary TKA and 6.8% for revision TKA. Infection was the most frequent reason for readmission among both primary and revision TKA groups. Multivariate analysis identified several risk factors for readmission, of which history of solid-organ transplant, congestive heart failure, and paralysis were identified for both primary and revision TKA. The c-statistics indicate that including inpatient variables in the predictive models (Primary TKA, c=0.647; Revision TKA c= 0.668) yielded slightly better results than using preoperative variables alone (Primary TKA, c=0.637; Revision TKA c=0.635).

CONCLUSION: These risk calculators may be useful in terms of appropriate patient selection for surgery, preoperative optimization, and postoperative interventions in order to reduce readmissions.

Intraoperative Adductor Canal Block for Augmentation of Periarticular Injection in Total Knee Arthroplasty

Abstract ID: Paper 195

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INTRODUCTION: Surgeons often sacrifice early function for pain control after total knee arthroplasty. Peripheral motor-sparing methods have recently gained interest to combat this compromise. Adductor canal block (ACB) and periarticular injection (PAI) have gained individual support. This study was proposed to evaluate the anatomic feasibility and safety of intraoperative ACB as an anatomic adjunct to PAI.

MATERIALS AND METHODS: Eleven fresh cadaveric knees underwent a standard medial parapatellar arthrotomy. Blunt finger dissection through sub-vastus medialis adipose tissue in the suprapatellar recess was done to palpate its origin. Using a 10 cc syringe, various colors of dyed liquid gelatin were injected through this towards the adductor canal (AC) using two needle configurations (3.5” x 20 gauge spinal needle; 1.5” x 18 gauge blunt fill needle). Injections were performed both proximal and distal in the pouch with the needles left in situ. Medial dissection of the knee and AC for each specimen was performed once the gelatin had cured. The position of each needle and location of injected dye was identified and described relative to anatomic borders of the AC.

RESULTS: With a blunt needle directed towards the distal AC, injectate was demonstrated in the AC 86% of the time. With a blunt needle directed towards the proximal AC, injectate was demonstrated in the AC 57% of the time. A spinal needle directed towards the proximal AC demonstrated injectate in the AC 14% of the time. Puncture of the femoral artery was observed with the proximal spinal needle 43% of the time and had the closest average proximity to the femoral artery with a distance of 5.9 mm. There were no vascular punctures using blunt needles and the average distance from the femoral artery with proximal and distal orientation was 10.2 mm (artery medial) and 15.4 mm (artery posterolateral), respectively.

CONCLUSION: Intraoperative ACB augmentation of PAI appears to be anatomically feasible and safe in a cadaveric model. There was decreased accuracy and increased risk of vascular puncture using a 3.5” spinal needle, while a blunt 1.5” needle directed towards the distal AC had the highest accuracy with minimal risk of vascular injury.

Preoperative Opioid Use: Is There an Association With Outcomes Following Joint Arthroplasty?

Abstract ID: Paper 196

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INTRODUCTION: The United States is in the midst of an opioid epidemic, with 80% of the global opioid supply being consumed in America. An unknown percentage of the joint arthroplasty population are on opioids prior to surgery. The purpose of this study was to evaluate opioid use after TKA, THA, and UKA comparing preoperative opioid users (OU) and non-opioid users (NOU); and to evaluate comorbidities and 90-day complication rates between these cohorts.

METHODS: The Humana Inc. administrative claims dataset was reviewed from 2007-2014 for patients undergoing primary TKA, THA, or UKA. Patients, comorbidities, and 90-day outcomes were identified using ICD-9/CPT codes and prescription opioid use was measured by monthly prescription fill rates. An OU user was defined as opioid prescription within 3 months prior to arthroplasty and NOU was defined as no history of prior opioid use.

RESULTS: Opioid use prior to surgery was identified for 41.4% of 84,685 TKA patients, 46.6% of 43,243 THA patients, and 42.5% of 4,463 UKA patients. Postoperatively, NOU had a lower number of patients discharged with opioids than OU for all procedures (TKA: 52% vs. 83%, THA: 44% vs. 74%, UKA: 56% vs. 82%; $p<0.05$ for all). Number of patients filling opioid prescriptions remained lower for NOU throughout the 12-month postoperative period at all time points ($p<0.05$). OU filled more opioid prescriptions than NOU postoperatively, but OU did decrease monthly prescription fill rates compared to their preoperative rates. OU had more medical comorbidities than NOU (higher Charlson Comorbidity Index; more obesity, smokers, diabetes, CHF, CAD, CKD, COPD, and CLD; $p<0.0001$). Ninety-day complications including respiratory failure, AKI, pneumonia, and SSI were higher among OU ($P<0.0001$ for all).

CONCLUSIONS: 41-47% of joint arthroplasty patients took opioids preoperatively. Opioid users had prolonged opioid use after surgery with more comorbidities and higher rates of postoperative complications. Monthly prescription fill rates did decrease for OU compared to preoperative values, but at 1 year, the percent of patients filling opioid prescriptions still remained higher than NOU for all 3 procedures (2.3-3% vs. 20.3-24.6%, $p<0.05$). These results support the importance of minimizing opioid use prior to and in the perioperative joint arthroplasty period.

Reducing Postoperative Blood Loss With Aminocaproic Acid in Primary TKA

Abstract ID: Paper 197

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BACKGROUND: Extensive blood loss following total knee arthroplasty (TKA) is common and often necessitates blood transfusions for patients. Studies suggest antifibrinolytic agents such as aminocaproic acid (ACA) reduce blood loss and blood transfusion rates in patients undergoing TKA. This study evaluated whether one 10g intraoperative dose of ACA in patients having primary, unilateral TKA would decrease perioperative blood loss, result in higher postoperative hemoglobin levels, as well as reduce postoperative blood transfusion rates.

METHODS: A retrospective chart review of 50 comparable cemented primary TKA cases was completed. 25 patients (ANTIFIB group) were given a single 10g intravenous intraoperative dose of ACA, 25 patients (CONTROL group) received no ACA dose.

RESULTS: The ANTIFIB group, which received ACA, had significant decreases in postoperative drain output, 155 cc vs. 410 cc, ($p<0.0001$) and postoperative blood transfusions, no units vs. 10 units, ($p<0.002$) compared to the CONTROL group. There were no adverse events noted in the ANTIFIB group.

CONCLUSIONS: One 10g intraoperative dose of ACA significantly reduced the perioperative blood loss and blood transfusion rates in patients having TKA compared with those of a similar cohort of patients in whom no antifibrinolytics were administered. The positive benefits of ACA were obtained without adverse event or complication.

Wound Hygiene Practices Following Total Knee Arthroplasty (TKA): Does It Matter?

Abstract ID: Paper 198

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INTRODUCTION: There is no consensus for a standardized postoperative wound care regimen. We investigated how early vs. delayed showering affects surgical site bacterial colonization following primary total knee arthroplasty and how important the ability to shower early is to patient satisfaction.

METHODS: Our study population consisted of patients undergoing primary TKA following a preoperative MRSA/MSSA screening and decolonization protocol. The surgical site skin was cultured at time points: (1) preoperatively, (2) intra-operatively following closure, (3) postoperative day 2 following dressing removal, and (4) 10-14 days postoperatively. Additionally at time point (4), a culture was obtained of the non-operative knee as a control and a survey assessing the subject's hygienic preferences was administered. After time point (3), the subjects were randomized into two groups: Early Group (N=16) was allowed to begin showering while Delayed Group (N=17) was instructed to keep their wounds dry until after time point (4).

RESULTS: 33 subjects (12 male, 21 female) with an average age of 60 and BMI of 34.76 enrolled in this study. The percentage of culture-positive subjects by time point were as follows: (1) 97%, (2) 0%, (3) 30%, (4–operative knee) 70%, and (4–nonoperative knee) 73%. At time point (4), Group 1 grew the following: 13% Staphylococcus aureus, 50% Staphylococcus epidermidis, 56% other gram-positives, 13% gram-negatives. Group 2 grew the following: 0% S. aureus, 41% S. epidermidis, 59% other gram-positives, 12% gram-negatives, and 6% fungus. There was no difference in growth between the groups (p=0.23–0.99) or between the nonoperative knee at time point (4) (p=0.49–0.87). There was no difference in growth based on smoking/alcohol status, history of diabetes, preoperative MSSA/MRSA or UTI, or discharge destination (home vs. rehab or skilled nursing facility). All S. aureus growth pre- and postoperatively was methicillin-sensitive. Prior to surgery, 81% of Group 1 subjects and 73% of Group 2 reported that they felt the ability to shower their wounds early vs. delayed was important. After having surgery, 94% of Group 1 and 80% of Group 2 reported that early showering was important, and that they ultimately preferred to shower early vs. delayed. There was no statistical difference in the survey responses between the two groups (p=0.33–0.58).

CONCLUSION: There is no difference in surgical site bacterial recolonization between early and delayed showering following primary TKA. However, if given a choice, patients prefer the option to shower early in the postoperative period.

Complication Rates in Total Hip and Knee Arthroplasties Performed by a "Low-Volume" Surgeon

Abstract ID: Paper 199

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INTRODUCTION: The emphasis of surgical volume-outcome research has increased recently with health management organizations and insurance companies under increasing pressure to reduce cost while maintaining high quality of care. Currently, the literature does not provide strong evidence of an association between a provider's total joint arthroplasty volume and patient outcomes. A few studies found a correlation between higher volumes and better patient outcomes, but are limited due to methodological imperfections. The objective of this study was to analyze patient outcomes of a single surgeon who may be considered "Low-Volume" and determine if complication rates, defined as mortality, infection, Deep Venous Thrombosis (DVT), Pulmonary Embolus (PE), pneumonia, and MI are the same as those reported in the literature for the higher volume surgeons.

METHODS: All 235 patients undergoing primary total hip (THA) or total knee arthroplasty (TKA) performed by the senior author from years 2010 to 2014 (5-year-span) were retrospectively reviewed. The maximum numbers of TKAs and THAs in a single year were 46 and 22, respectively. Complications assumed to be related to surgery were defined as occurring within the 90-day postoperative period. Any erythema treated with re-incising the knee/hip without opening the capsule was considered superficial Surgical Site Infection (SSI). Any erythema treated with re-incising the knee/hip as well as the capsule was considered deep SSI.

RESULTS: 169 total TKAs and 66 total THAs were performed. There were 2 cases of deep vein thrombosis (DVT) (1.2%), one case of pulmonary embolus (PE) (0.6%), 4 superficial SSIs (2.4%), 0 deep SSIs, and 0 mortalities in TKA patients. 66 total THAs were performed. There were no DVTs, PEs, mortalities, infections, cases requiring revision, pneumonias, or MIs in these THA patients.

DISCUSSION: Recent studies on patient outcomes in THA and TKA report decreased complications with increase in surgical volume. Depending on the study quoted, acceptable rate for infection is about 3% for TKAs and 2% for THA. Our study reveals similar complication rates to those published in the literature by high volume surgeons, demonstrating that "low-volume surgeons" may have equivalent outcomes to those performing greater numbers or arthroplasties. This study, therefore, has important implications, as compensation may be unnecessarily decreased and/or withheld for surgeons who are considered "low-volume" by insurance companies and/or regulatory agencies.

Outcomes of Patellofemoral Arthroplasty Based on Radiographic Severity

Abstract ID: Paper 200

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BACKGROUND: Patellofemoral arthroplasty (PFA) is increasing in frequency as treatment for isolated patellofemoral arthritis. Recent reports with modern implants have shown 97% survivorship at 4 years. The indications for PFA include isolated patellofemoral arthritis in the absence of tibiofemoral arthritis as evidenced by radiographs and MRI. Although very sensitive, MRI can occasionally be misleading in defining the severity of patellofemoral arthritis. MRI findings consistent with chondromalacia, in the absence of x-ray evidence of patellofemoral arthritis may lead to less predictable outcomes in terms of pain relief, functional, and clinical outcomes.

METHODS: A retrospective review identified 72 knees (55 patients) that underwent PFA for isolated degenerative patellofemoral arthritis between 2002 and 2013. Preoperative and postoperative radiographs and MRI images were reviewed. Patellofemoral arthritis was classified according to the Iwano classification system from 0-IV. Clinical outcomes were evaluated using the Knee Society scores (KSS) for pain and function. Complications and implant survivorship were also evaluated. Mean age at the index surgical intervention was 51 years (range 36–81 years). Mean follow-up was 3 years (range 2-5 years).

RESULTS: Of these, there were 16 Iwano grade I, 17 grade II, 21 grade III, and 18 grade IV. All had grade III-IV chondromalacia on preoperative MRI. When the patients were stratified by Iwano classification, there was a statistically significant difference between grade I patients compared to grade II-IV. A significantly lower mean increase in KSS pain scores (22 vs. 30, p 0.054) and in KSS function scores (10 vs. 22, p 0.041) between the grade I vs. II-IV group. The 2-year survivorship free from any reoperation was 88.6%, free from any revision was 100%, and from revision for aseptic loosening was 100%. At most recent follow-up, 1 revision to total knee arthroplasty occurred 5 years after the index procedure. There were 2 minor complications in the grade I group and 11 in the II-IV group, all of which occurred at less than 2 years postoperatively.

DISCUSSION AND CONCLUSION: Regardless of grade of chondromalacia seen on MRI, patients with grade I patellofemoral arthritis showed a significantly lower increase in KSS for pain and function than those with grade II-IV. Therefore, an Iwano grade of at least II may be a more reliable predictor of favorable outcomes following PFA than findings of grade III-IV chondromalacia on MRI. Caution should be utilized when considering PFA for patients who have minimal radiographic evidence of arthritis.

Radiographic Predictors of Clinical Outcomes Following Total Knee Arthroplasty

Abstract ID: Paper 201

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INTRODUCTION: Predicting satisfaction following total knee arthroplasty (TKA) continues to be a clinical challenge. We sought to quantify radiographic variables associated with clinical improvement and satisfaction following TKA.

METHODS: We reviewed a consecutive series of primary TKAs performed by a single surgeon with a minimum two-year follow-up. Radiographic variables assessed included pre- and postoperative mechanical axis alignment, osteophyte size and location, and the presence of tibial or patella subluxation. Measurements were taken using a calibrated ruler and goniometer using digital radiographs. Knee Society Scores (KSS), satisfaction, and range of motion (ROM) were prospectively collected.

RESULTS: A total 151 TKAs were followed with a minimum 2.3 year follow-up (mean 4.2 ± 0.85). Eleven were not satisfied, 9 were satisfied with minor complaints, and 131 were completely satisfied after TKA. Increasing size of patella and lateral compartment osteophytes, particularly greater than 5 millimeters (mm), was significantly associated with improvement in KSS knee scores ($p<0.05$). Patient satisfaction was also strongly associated with these variables and appeared independent of mechanical axis alignment.(Figure 1). A regression model demonstrated that lateral patella osteophytes and lateral compartment osteophytes continued to have a significant association with improvement in KSS knee scores after controlling for potential confounders (Table).

DISCUSSION/CONCLUSION: We observed a significant association between size of patella and lateral compartment osteophytes and improvement in KSS knee scores following TKA. These radiographic variables were also predictive of satisfaction following TKA. KSS function scores were not significantly associated with the radiographic variables assessed in this study. These findings may help guide clinician and patient expectations regarding improvement following TKA.

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MAOA BREAKOUT SESSION #14
SHOULDER
April 16, 2016

Preoperative Humeral Head Elevation as a Risk Factor for Scapular Notching

Abstract ID: Paper 202

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PURPOSE: To measure preoperative radiographic humeral head elevation in patients undergoing reverse total shoulder arthroplasty to determine if degree of elevation is a risk factor for scapular notching 1 year after surgery.

METHODS: A single center retrospective review of patients treated by one surgeon with reverse shoulder arthroplasty with adequate preoperative and postoperative radiographs was performed. Preoperative radiographs were analyzed for relative humeral head elevation with respect to the glenoid using two measurement methods (head center and shoulder elevation). Without knowledge of degree of humeral head elevation, postoperative (1 year) radiographs were graded for scapular notching (Nerot Grade 1-4). The data were then combined and statistically analyzed for significant ($p<0.05$) differences in degree of elevation among grades, differences in proportions of notching grades, and strength of correlations between elevation and notching.

RESULTS: 59 patients met inclusion criteria. Humeral head center elevation for patients with notching (grade 1-4) (12% ± 7%) was significantly higher ($p=0.038$) than for patients without notching (5% ± 7%). Patients with head center elevation ≥ 20% were significantly ($p=0.05$) and 7 times more likely to have notching at 1 year after surgery. For high-grade notching (grade 3,4) humeral head center elevation (14% ± 10%) was significantly higher ($p=0.048$) than for patients with low-grade notching (grades 0-2) (8% ± 6%). Patients with head center elevation ≥ 25% were significantly ($p=0.045$) and 2 times more likely to have high-grade notching at 1 year after surgery. Shoulder elevation for patients with notching (grade 1-4) (23% ± 10%) was significantly higher ($p=0.044$) than for patients without notching (14% ± 10%). Patients with shoulder elevation ≥ 20% were significantly ($p=0.009$) and 5 times more likely to have notching at 1 year after surgery. Degree of shoulder elevation was not significantly different between high-grade and low-grade notching at 1 year after surgery, and correlations between degree of elevation and scapular notching grade were not strong ($r<0.4$) for either measurement. However, when both preoperative head center elevation and shoulder elevation were ≥ 20%, patients were significantly ($p=0.03$) and 9 times more likely to have notching at 1 year after surgery.

DISCUSSION: Degree of humeral head elevation determined by standardized preoperative radiographic measurements is a significant risk factor for scapular notching 1 year after reverse total shoulder arthroplasty. Preoperative measurement of both head center elevation and shoulder elevation are recommended in order to identify patients with higher risk for notching.

Computed Tomography and Magnetic Resonance Imaging Are Equally Reliable in the Assessment of Glenohumeral Arthritis and Glenoid Version

Abstract ID: Paper 203

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BACKGROUND: Accurate characterization of glenoid deformity is an important aspect of preoperative planning in shoulder arthroplasty. Axillary lateral radiography (AXR), computed tomography (CT), and magnetic resonance imaging (MRI) have been advocated for these assessments. The purpose of this study was to compare the intra- and inter-observer reliability of CT and T2 weighted MRI when grading the severity of glenoid wear, glenohumeral subluxation, and glenoid version.

MATERIALS AND METHODS: Sixty-one shoulders with the diagnosis of primary osteoarthritis underwent CT and MRI scans prior to shoulder arthroplasty. The best representative axial CT and T2 weighted MRI images of glenoid wear and glenohumeral subluxation were obtained. All slices were blinded and randomized prior to evaluation. Two fellowship-trained shoulder surgeons and three orthopedic surgery trainees reviewed the images to classify glenoid wear (Walch and Mayo classifications) and glenohumeral subluxation (Mayo classification). Intraobserver reliability for the Walch, Mayo glenoid, and Mayo subluxation classifications was determined using Spearman's correlation coefficient while interobserver agreement was determined using Congers kappa. Reliability of glenoid version measurements was determined using the Pearson correlation coefficient for both interobserver agreement and intraobserver reliability.

RESULTS: Intraobserver reliability for the CT group was 0.71, 0.73, and 0.64 for the Walch, Mayo glenoid, and Mayo subluxation classifications; indicating good agreement. Intraobserver reliability for the MRI group was 0.71, 0.52, and 0.62 for the Walch, Mayo glenoid, and Mayo subluxation classifications; indicating fair to good agreement.

Interobserver reliability for the CT group was 0.29, 0.35, and 0.33 for the Walch, Mayo glenoid, and Mayo subluxation classifications; indicating poor agreement. Interobserver reliability group for the MRI group was 0.34, 0.27, and 0.40 for the Walch, Mayo glenoid, and Mayo subluxation classifications; indicating poor to fair agreement.

For the measurement of glenoid version, average intraobserver reliability was 0.79 for the CT group and 0.90 for the MRI group, indicating good agreement in the CT group and substantial agreement in the MRI group. Interobserver agreement was 0.75 for the CT group and 0.79 for the MRI group, indicating good agreement.

CONCLUSION: These results suggest CT and MRI are equally reliable for the classification of glenohumeral wear patterns. For the measurement of glenoid version, MRI was slightly more reliable than CT within observers. We conclude both CT and MRI can be reliably used as preoperative planning tools for assessment of glenoid deformity in shoulder arthroplasty.

Shoulder Arthroplasty for Locked Anterior Shoulder Dislocation

Abstract ID: Paper 204

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INTRODUCTION: Locked anterior shoulder dislocation (LASD) is a rare condition that can lead to bone loss, instability, and soft tissue contractures. In severe cases, soft tissue procedures may be unsuccessful and shoulder arthroplasty (SA) may be considered. Currently, there is paucity of literature on outcomes of SA for LASD. The purpose of this study was to assess outcomes of SA for LASD.

METHODS: Between 1976 and 2013, 21 SAs in 21 patients were performed for chronic LASD. Two patients were lost to follow-up prior to 2 years and were excluded. The remaining 19 shoulders (3 hemiarthroplasties [HA], 7 total shoulder arthroplasties [TSA], and 9 reverse shoulder arthroplasties [RSA]) were followed for ≥ 2 years or until re-operation. The median time between the index dislocation episode and SA was 32 weeks (2 weeks-32 years). Outcome measures included pain, range of motion, modified Neer ratings, ASES scores, complications, and survivorship.

RESULTS: Nineteen shoulders, with a mean age of 62 years (range 34-80), were analyzed at a mean follow-up of 6.3 years (range 2-30). Pain improved from 4.7 to 2.2 ($p<0.001$) on a 5 point scale, but was moderate or severe in 21% of SAs. Average elevation and external rotation improved from 51 and 1° to 94 and 34° ($p=0.004$ and 0.01). No difference was seen between non-RSA (HA/TSA) and RSA with regards to postoperative pain ($p=0.25$), elevation ($p=0.5$), or external rotation ($p=0.2$). Six patients rated their shoulder as much better, 7 as better, 5 as the same, and 1 as worse. Of the 10 non-RSA, 4 (40%) had moderate or severe anterior subluxation postoperatively. No radiographic instability was identified with RSA. Three (16%) shoulders required reoperation, 2 for instability after TSA, and 1 for glenoid arthritis after HA. No RSA underwent reoperation. The 5- and 10-year survival (reoperation-free) rates were 89% and 77%, respectively. Postoperative ASES averaged 65 (range 28-100). There were 2 excellent, 7 satisfactory, and 10 unsatisfactory modified Neer ratings. Non-RSA trended towards a greater risk of reoperation ($p=0.08$), subluxation ($p<0.001$), poor satisfaction ($p=0.06$), lack of subjective improvement after surgery ($p=0.03$), and lower ASES ($p=0.08$) compared to RSA.

CONCLUSION: SA for the treatment of LASD has a high rate of subluxation and relatively poor functional outcome scores with traditional HA or TSA implants. RSA has improved outcomes in this population by maintaining a stable glenohumeral joint. RSA should be considered whenever SA is performed for LASD.

Deltoid Deficiency is Not a Contraindication to Reverse Total Shoulder Arthroplasty

Abstract ID: Paper 205

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INTRODUCTION: Deltoid disruption has traditionally been an absolute contraindication to performing a reverse total shoulder arthroplasty (RTSA) for rotator cuff tear arthropathy. Patients were left with minimal treatment options including arthrodesis, resection arthroplasty, or hemiarthroplasty – all providing limited function. We present a series of patients with deltoid tears that underwent concomitant RTSA with deltoid reconstruction. This reconstruction was either direct repair of their deltoid tear, or a rotationplasty, where the posterior and/or middle heads of the deltoid were rotated to substitute for deficient middle and/or anterior heads. We hypothesize that this combined procedure provides an acceptable, functional alternative for this complex patient population.

MATERIALS AND METHODS: From 2004 to 2012, we retrospectively identified patients who were treated with a concomitant RTSA and deltoid reconstruction with minimum 24-month follow-up. Six shoulders in five patients met this criteria. The average age was 69 years (61-79 years) with an average follow-up of 76.8 months (24 to 133 months). There was one iatrogenic deltoid tear (from a previous surgery), two attritional tears, and three traumatic tears included. The anterior deltoid was affected in 5/6 shoulders, the middle in 3/6 shoulders, and all had their posterior deltoid preserved. We compared pre- and postoperative range of motion and Penn Shoulder Scores, including subscores, using paired t-tests.

RESULTS: Mean forward elevation (FE) and external rotation (ER) increased from a preop of 48° and 12°, respectively, to 120° and 22°, respectively (Table 1). Penn scores increased from 45.2 preoperatively to 72.6 postoperatively. The Penn Satisfaction subscore, in particular, improved from 1.1 (out of 10) to 8.8 (p=0.005). There were no infections, revisions, or implant loosening or failure.

CONCLUSION: Deltoid reconstruction at the same time as RTSA is a good treatment option for salvage of patients with rotator cuff tear arthropathy and deltoid deficiency. It results in a functional shoulder with a high level of satisfaction and good motion. The average forward elevation and external rotation achieved, combined with a functional elbow, allow for patients to perform many activities of daily living.

Click here to view Table 1

Safety and Efficacy of Shoulder Arthroplasty Following Previous Periprosthetic Joint Infection

Abstract ID: Paper 206

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INTRODUCTION: Periprosthetic joint infection (PJI) is a known complication following arthroplasty that may be managed with revision or chronic suppression. There remains debate if arthroplasty is safe in patients with a previous PJI. The objective of this study is to determine whether patients with a history of a properly treated PJI after a total hip (THA) or total knee (TKA) arthroplasty can safely undergo shoulder arthroplasty without an increased risk of shoulder infection or a compromise of their clinical outcomes.

METHODS: Between 2002 and 2013, 37 patients with successful treatment of an infected THA or TKA underwent a subsequent primary shoulder arthroplasty at our institution. Eleven were on chronic suppression at the time of shoulder surgery and 26 were considered to have eradication of infection and were not on chronic suppression. Three shoulders were lost to follow-up. The remaining 34 shoulders (10 on chronic suppression) were followed for a minimum of two years or until reoperation with a mean follow-up of 3.6 years (range, 2 to 9.4 years). The mean time between PJI treatment and shoulder arthroplasty was 5.5 years (range, 0.7 to 13.1 years). There was no statistically significant difference in mean age (75 years), gender (56% male), BMI (32), ASA (2.5), Charlson comorbidity index (4.0), or prevalence of diabetes (15%) between both groups. Radiographic outcomes including implant loosening and failure, as well as clinical outcomes including range of motion, pain, patient satisfaction, modified Neer ratings, and ASES scores were analyzed.

RESULTS: Shoulder arthroplasty led to improved pain scores in both groups ($p<0.01$). According to the modified Neer score rating, excellent or satisfactory outcomes were achieved in 80% (8/10) in the chronic suppression group, and 75% (18/24) in the reimplantation group. ASES scores averaged 70.3 (range, 36.7 - 100), with no difference between groups ($p=0.72$). One patient with a previously infected THA underwent revision surgery for an infected shoulder arthroplasty following a periprosthetic fracture sustained three years after the index procedure. There were no other shoulder infections. Infection free survival at final follow-up was estimated to be 93.3% (SD 6.4%).

DISCUSSION: Shoulder arthroplasty in patients with a previously treated PJI after hip or knee arthroplasty seems to be safe, with a low rate of infection. A history of properly treated lower extremity deep periprosthetic infection should not be considered a contraindication or risk factor for failure of a subsequent shoulder arthroplasty.

Increased Implant Conformity Results in Early Glenoid Component Radiographic Lucency After Anatomic Total Shoulder Arthroplasty

Abstract ID: Paper 207

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INTRODUCTION: Glenoid component loosening remains the main mode of failure following total shoulder arthroplasty (TSA). Mismatch between the radius of curvature of the glenoid and humeral component dictates implant conformity and has been shown to influence glenoid stress but optimal implant conformity remains controversial. Our aim was to assess the effect of implant radial mismatch on early glenoid radiolucency. To our knowledge, this is the first study to look at the influence of implant conformity on early glenoid radiolucency following TSA.

METHODS: Patients who underwent anatomic TSA with an all-polyethylene anchor pegged glenoid for osteoarthritis between 2005 and 2014 by three board-certified shoulder surgeons were retrospectively enrolled and divided into group 1 (n=80) with 3 mm radial conformity mismatch and group 2 (n=37) with 1 mm conformity mismatch between glenoid and humeral components. Implant version and radiolucency were assessed using biplanar radiographs taken 6 to 24 months after surgery. Radiolucency around the center peg was graded by consensus read among three examiners as grade 1: frank osteolysis; grade 2: bone to the edge of the flanges; and grade 3: complete bone integration. Glenoid version, inclination, and morphology (Walch classification) were assessed using preoperative computed tomography images. A multivariate logistic regression analysis was used to control for other predictors of early radiolucency.

RESULTS: The demographics, comorbidity profile, smoking habits, native glenoid version, inclination, and implant version were not statistically different between the two groups. The rate of early radiolucency was significantly higher in patients with more conformed implants (32.4% vs. 13.8%, P=0.01). Age, gender, body mass index, glenoid version, inclination, and morphology as well as implant version were not predictors of radiolucency in our model. Walch type A, B, and C glenoids had 16.7%, 20.3%, and 50% radiolucency, respectively (P=0.27). There was no statistically significant difference in rate of early radiolucency between grafted and not grafted cases (21.0% vs. 17.5%; P=0.91). Eleven patients (9.2%) had a history of diabetes and the rate of radiolucency was significantly higher in these patients compared to the rest of the cohort (54.5% vs. 15.7%; P=0.003).

CONCLUSION: Increased implant conformity and history of diabetes was associated with early glenoid radiolucency following TSA. Increasing radial conformity can lead to increased implant contact pressure and potentially higher volumetric wear which can lead to radiolucency as early as 6 months after TSA. The association between diabetes and early radiographic lucency can have implications for patient selection.

Participation In Work and Sport Following Total Shoulder Arthroplasty – A Comparison Of Reverse And Anatomic

Abstract ID: Paper 208

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INTRODUCTION: Both anatomic (TSA) and reverse shoulder arthroplasty (RSA) are routinely used to manage patients with a range of shoulder pathologies whom desire to continue to work or participate in sports. The purpose of this study is to report the functional ability of patients treated with TSA and RSA to work and participate in sports based on responses to clinical outcome surveys.

METHODS: A retrospective review of the shoulder surgery repository was performed for all patients treated with TSA and RSA who completed questions 9 and 10 on the activity patient self-evaluation portion of the American Shoulder and Elbow Surgeons (ASES) Assessment Form. Patients with a minimum 1 year follow-up were included if a sport or work was identified. A total of 179 patients with TSA and 156 patients with RSA were included in the analysis. Comparisons were made between TSA and RSA for the specific ASES score (rated 0-3) reported for ability to work and participate in sports, including overall scores and scores based on specific sports and line of work reported. Comparisons were also made between sports predominantly using shoulder function and those that do not.

RESULTS: Patients with TSA reported a significantly higher overall ability to participate in sports, with average ASES sport-specific score of 2.5 compared to 1.8 for RSA patients ($p=0.0001$). Patients with TSA also reported a significantly higher overall ability to work, with average ASES work-specific score of 2.6, compared to 2.1 for RSA patients ($p=0.0001$).

Amongst specific sports, TSA patients were reported significantly higher scores for the ability to participate in aquatic sports (2.7 vs. 1.8 $p=0.009$); however, no significant differences were observed for reported scores for golf, walking, gym exercises, racquet sports, etc.

Amongst specific work activities, TSA patients reported significantly higher scores housework (2.7 vs. 2, $p=0.00001$) and gardening (2.8 vs. 1.7, $p=0.022$); however, no significant differences were observed for other work activities including retirement work, desk job, jobs involving prolonged standing, gardening, etc.

Amongst the subset of sports that involve shoulder function, TSA patients were significantly more likely to describe maximal ability to participate (score of 3) than RSA patients (64% vs. 41%, $p=0.0001$).

CONCLUSION: Both TSA and RSP allow for participation in work and sport, with TSA patients reporting better overall ability to participate. For sports involving shoulder function, TSA patients more commonly report maximal ability to participate than RSP patients.

Short-Term Outcomes of Posterior-Augmented Glenoid Component for Glenoid Retroversion in Total Shoulder Arthroplasty

Abstract ID: Paper 209

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INTRODUCTION: The incidence of total shoulder arthroplasty (TSA) is increasing in the United States. Modern implants have good long-term survivorship; however, glenoid component failure remains an important reason for dissatisfaction after shoulder replacement. Glenoid component malposition, including retroversion, has been shown to increase risk of failure. A number of implant options and surgical techniques have been utilized to address posterior glenoid bone loss and glenoid dysplasia. Included in these options is that of a posterior augmented glenoid component. The purpose of this study was to assess functional outcome scores, objective clinical measurements, patient satisfaction, and early complications when using a posterior augmented, all-polyethylene glenoid component for glenoid retroversion in primary total shoulder arthroplasty.

METHODS: After IRB approval was obtained, we identified all patients who had undergone TSA with a posterior augmented glenoid component by a single shoulder and elbow fellowship-trained orthopedic surgeon. The charts of all patients with a minimum of one year of postoperative follow-up were retrospectively reviewed and preoperative glenoid version, preoperative and postoperative simple shoulder test (SST), visual analog scale (VAS) pain score, and forward elevation (FE), external rotation (ER), and internal rotation up the back (IR) range of motion data were collected, along with postoperative subjective shoulder value (SSV) and patient satisfaction.

RESULTS: Twenty-five patients met our inclusion criteria at a mean follow-up of 23.2 months (range 12.0 - 40.9). The mean age was 69 years (range 55 - 88), and the mean preoperative glenoid retroversion was 23.1° (range 16.8 - 35). All measurement values improved between the preoperative and the postoperative time periods. Mean VAS pain score decreased (7.2 vs. 1.1, $p<.001$), SST values improved (4.1 vs. 8.6, $p<.001$), and range of motion increased: FE (96.0 vs. 145.0, $p<.001$), ER (10.8 vs. 49.6, $p<.001$), and IR (L4 vs. T11, $p<.001$). The mean postoperative SSV was 87.3% and all 25 patients were “satisfied” or “very satisfied” with their shoulder replacement. The only complication was a patient who developed a periprosthetic infection and required revision surgery.

DISCUSSION AND CONCLUSION: Excessive glenoid retroversion is a difficult problem for many patients undergoing TSA, with a number of options for treatment. The utilization of a posterior augmented, all polyethylene glenoid component for TSA in the setting of significant retroversion results in improvements in patient-assessed function, objective clinical measures, and patient satisfaction with few complications in short-term follow-up.

The Anatomy of the Clavicle and Its In Vivo Relationship to Vascular Structures

Abstract ID: Paper 210

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BACKGROUND: Many surgeons fail to understand the risks related to operating around the clavicle. In order to further highlight the anatomy of the clavicle and its relationship to adjacent vascular structures, an in vivo study was performed highlighting various risks. The aim of this study is to attempt to map “safe zones” and “danger zones” in regard to major vascular structures during the surgical approach and application of hardware about the clavicle.

METHODS: De-identified CT Chest Angiograms were reviewed from the electronic database at our institution. A 2D/3D reconstruction software program was then used to reconstruct the clavicle and adjacent structures of interest to provide coronal and sagittal reconstructions. Clavicle was then divided into 13 segments. Distance and angular measurements were made from the clavicle to the closest arterial and venous structure. Statistical analysis was performed defining mean and median distances of vascular structures to the clavicle at each of the 13 points. Linear regression models were then utilized to estimate the predicted value and lower limit of the 95% prediction interval for the artery/vein distance from the clavicle.

RESULTS: 76 clavicles on 62 patients were reviewed. Average patient age was 45 years. Average clavicular length was 122.78 for the right clavicle and 118.7 for the left. 95% confidence interval placed the venous structures within 1 cm of the clavicle on the first 6 positions of both the left and right clavicle. The artery was found closest to the clavicle at the 5th, 6th, and 7th positions at average distances of 15-18 mm. No significant difference was found with respect to distance to vascular structures when sex and age were considered.

CONCLUSIONS: Our in vivo study utilizing CT angiograms demonstrated that the vascular structures, particularly the subclavian vein, are in real danger at the medial aspect of the clavicle extending to mid shaft during operative intervention on and around the clavicle. This study represents the largest anatomic study looking at the anatomy of the clavicle. Measuring 13 data points provides us with detailed relationship of the vasculature that will assist surgeons in working on and around the clavicle.

Younger Patients Report Similar Activity Levels as Older Patients Following Reverse Total Shoulder Arthroplasty

Abstract ID: Paper 211

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(Presented by Thomas R. Acott, M.D. / Memphis, TN)

BACKGROUND: Reverse total shoulder arthroplasty (RTSA) has become an established treatment for rotator cuff deficient conditions to reduce pain and restore function. As indications for the procedure expand, conventional wisdom holds that younger patients will have higher activity levels and place higher stresses across the prosthesis with subsequent increased risk for failure. But little is known to support or refute this supposition. The purpose of this study was to define the patient-reported activity levels of patients younger and older than 65 years following RTSA and to evaluate any differences between age cohorts.

METHODS: Forty-six patients who underwent primary RTSA by a single surgeon answered a previously reported questionnaire regarding their activity level. Respondents' data was categorized and tabulated according to pain, range of motion, strength, and activity level (low, medium, and high demand). Fisher's exact test, chi square test, and independent t-test statistical analyses were performed. Differences with $p<0.05$ were considered statistically significant.

RESULTS: Seventeen patients younger than age 65 (average 57.7 years) and 29 patients older than age 65 (average 75.2 years) were included in the study. No significant differences were found for range of motion, strength, or number of activities.

When comparing age groups, 47% of younger patients and 44% of older patients reported high demand activities ($p=0.64$). And 24% of younger patients and 37% of older patients reported medium demand use ($p=0.30$). Patients younger than 65 were more likely to require narcotic pain medication ($p=0.002$) and were more likely to be disabled ($p=0.0001$). They also had slightly higher pain levels (3.9 vs. 2.7) though this difference did not reach statistical significance ($p=0.12$).

DISCUSSION: Patient reported activity levels were similar in this study between younger and older age groups following RTSA. These data provide initial evidence that the commonly held concern of higher activity levels among younger patients with RTSA placing excessive demands on the prosthesis compared to older patients may not be as important as currently thought. Rather, patients seem to self-regulate their activities to minimize pain and maximize essential functions after surgery. These data provide a basis for further study on the activity levels of younger patients after RTSA.

Modular Endoprosthetic Reverse Total Shoulder Arthroplasty for Massive Proximal Humeral Bone Loss

Abstract ID: Paper 212

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BACKGROUND: Proximal humeral bone loss presents a challenge for surgeons in restoring function of the shoulder and quality of life to patients. The absence of a functioning rotator cuff and loss of bone length poses a challenge with regards to regaining range of motion and restoring muscle tension. Treatments such as tumor prostheses and allograft-prosthesis composites have resulted in less than ideal outcomes. We proposed to report the early term clinical results of a modular reverse total shoulder endoprosthesis in patients with massive proximal humeral bone loss.

METHODS: Seven patients with massive proximal humeral bone loss due to either nonunion following fracture (1), failed primary arthroplasty (6), or tumor resection (2) underwent modular endoprosthetic reconstruction with a reverse shoulder arthroplasty construct. All patients had at least one year of clinical and radiographic follow-up (average 369. 3 days range 291-477 days). Demographic data including age, sex, and BMI were collected. Pain was determined by visual analog score (VAS). Functional outcomes were assessed with ASES score, QuickDASH score, active range of motion, and strength testing. Radiographs were reviewed to evaluate the extent of bone loss, particularly referable to the deltoid tuberosity, as well as signs of loosening and component failure. Complications were defined as need for revision surgery or by radiographic evidence of component failure. Two-tailed t-tests were used to assess changes in VAS, functional scores, ROM, and strength. Differences with $p<0.05$ were considered statistically significant.

RESULTS: There were 3 males and 6 females included in the study with an average age of 59.4 years (22-78), and average BMI of 35.9 (25.5-52). The average preoperative VAS was 6.1 and the average postoperative VAS was 2.75 ($p=0.062$). The average ASES score improved from 40.5 to 62 ($p=0.01$), and the average quickDASH score improved from 73.3 to 43.1 ($p=0.004$). The average forward elevation improved from 22° preoperatively to 88° postoperatively ($p=0.0001$). The average internal rotation improved from 22° preoperatively to 38° postoperatively ($p=0.03$), and the average external rotation improved from 23° preoperatively to 32° postoperatively ($p=0.17$). Forward elevation strength improved from an average of 1.8 to 4.3 ($p<0.0001$). There were 2 complications; one due to humeral component loosening and one dislocation requiring revision of the humeral component.

CONCLUSIONS: Use of a modular endoprosthetic reverse total shoulder arthroplasty is a reasonable option for patients with massive proximal humeral bone loss, resulting in significant improvements in functional scores, ROM, and strength at early term follow-up.

Level of evidence: IV

Does Prolonged Use of Walkers in Shoulder Arthroplasty Patients Lead to Accelerated Failure Rates?

Abstract ID: Paper 213

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INTRODUCTION: The number of shoulder arthroplasties performed yearly continues to grow steadily. As our population becomes older, a certain percentage of patients become reliant on gait aids due to declining health, lower extremity arthritis or injuries, and some may be candidates for shoulder arthroplasty. The effects of use of gait aids on the shoulder joints after arthroplasty is largely unknown, and there is no consensus amongst orthopedic surgeons to counsel patients regarding the longevity of either anatomic or reverse arthroplasty designs when the upper extremities are used to bear weight through gait aids. The purpose of this study was to determine the outcome of shoulder arthroplasty in patients who use a walker routinely.

MATERIALS AND METHODS: Our institutional database allowed us to identify 53 shoulders (41 patients) that had undergone a primary shoulder arthroplasty, had been followed for a minimum of two years, and required concurrent use of a walker. There were 10 hemiarthroplasties, 33 anatomic total shoulder arthroplasties, and 10 reverse shoulder arthroplasties. The mean follow-up time from the time of shoulder arthroplasty was 63 months (range, 24–156), and the mean time of use of a walker was 30 months (range, 24-89). Shoulders were assessed for pain, range of motion, Neer ratings, satisfaction, complications, and reoperations.

RESULTS: At most recent follow-up, only three patients had required reoperation for infection, glenoid loosening, and glenoid erosion, respectively at a mean of 52 months after the index arthroplasty. Forty shoulders were pain free (75%) with two shoulders reporting moderate pain at follow-up. As expected, shoulder arthroplasty resulted in motion improvements in both elevation and external rotation to 132° and 55°, respectively. At most recent follow-up, 46 of the shoulders received satisfactory ratings, and no patients expressed difficulty in use of their walker due to their concomitant shoulder replacement. There were a total of 25 excellent, 15 satisfactory, and 13 unsatisfactory results based on modified Neer ratings. Postoperative ASES scores averaged 79 (Range, 54-100).

CONCLUSION: Use of a walker routinely does not seem to lead to an increased rate of shoulder arthroplasty failure at short to mid-term follow-up. Further studies are required to understand if that is also the case with longer follow-up.

National Proximal Humerus Fracture Treatment Trends, 2004-2012

Abstract ID: Paper 214

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INTRODUCTION: Surgial treatment of proximal humerus fractures (PHF) is largely surgeon dependent with no clear guidelines for selecting the method of treatment. The purpose of this study was to assess trends in the use of open reduction and internal fixation (ORIF), closed reduction and internal fixation (CRIF), hemiarthroplasty (HA), reverse shoulder arthroplasty (RSA), and nonsurgical treatment (NST) for the management of PHF in the United States from 2004-2012.

METHODS: The National Inpatient Sample (NIS) was used to identify all patient discharges with diagnosis codes for PHF from 2004-2012. The ICD-9 code for total shoulder arthroplasty was used as a surrogate for RSA until 2010 when a separate code was introduced. Linear regression analyses were performed to evaluate treatment trends. Analysis of variance (ANOVA) was used to determine significant variations.

RESULTS: A national estimate of 550,116 PHF discharges was identified over the time period. NST was the most common treatment (61.8%), ORIF was second (23.4%), followed by HA, CRIF, and RSA (10.4%, 2.6%, and 1.8%, respectively). Patients treated with RSA, NST, and HA were, on average, older than those treated with ORIF and CRIF ($p<0.001$). The number of chronic conditions was the highest in NST (5.00), followed by RSA (4.69). RSA had the highest total charges ($72,210.31) compared to by HA ($55,518.27), ORIF ($53,665.06), CRIF ($42,303.15), and NST ($34,404.88). The RSA cohort had the shortest average length of stay (LOS) (4.36 days) while NST patients had the longest LOS (5.61 days) and the highest in-hospital mortality rate (3.1%). Significant correlations between change over time and treatment modality were found for RSA ($r=0.903$, $p<0.001$), ORIF ($r=0.876$, $p=0.002$), and CRIF ($r=-0.922$, $p<0.001$). The RSA regression model was used to extrapolate that by the year 2020, PHF treated with RSA will increase 84% from 2012.

CONCLUSION: There were significant changes in treatment modalities for PHF from 2004-2012; however, NST remained most common. As expected, those with NST had the highest number of chronic conditions and were among the oldest patients; and ORIF were the youngest patients and had the lowest number of chronic conditions. RSA demonstrated the most expensive treatment but also the shortest average LOS. RSA had the greatest proportional increase over time, but only accounted for a total of <2% of total interventions. The projected number of RSA used to treat PHF will be about 5,600 in 2020, compared to 350 in 2004.

Click here to view Figure 1

Outpatient Total Shoulder Arthroplasty in the Ambulatory Surgery Center Environment is a Safe Alternative to the Inpatient Hospital Setting: A Matched Cohort Study

Abstract ID: Paper 215

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BACKGROUND: Total shoulder arthroplasty (TSA) is a well-recognized treatment for glenohumeral arthritis. As the health care policy environment continues to evolve, increasing emphasis has been placed on high quality healthcare that can be delivered in a safe, efficient, and cost-effective way. To that end, there has been recent increased interest in outpatient total joint arthroplasty. We proposed to compare a matched cohort of outpatient total shoulder arthroplasties with those performed in the inpatient hospital setting to evaluate episode-of-care complications.

METHODS: Twenty-five patients underwent outpatient TSA at a freestanding ambulatory surgery center (ASC). An age and co-morbidities matched cohort consisted of 25 patients undergoing TSA in the traditional inpatient hospital setting. Ninety day episode-of-care measures included hospital (re)admissions, reoperations, and complications. Cost of care was evaluated by total facility charges in the ASC cohort. Two-tailed t-tests were used to evaluate differences between ASC and inpatient groups. Differences with $p<0.05$ were considered statistically significant.

RESULTS: No statistically significant differences were seen between the ASC and hospital cohorts regarding average age (51.0 vs. 53.2), preoperative American Society of Anesthesiologists (ASA) score (2.1 vs. 2.3), operative indication, and body mass index (32.0 vs. 32.1). None of the patients required re-operation. There were no hospital admissions from the ASC cohort and no re-admissions from the hospital cohort. There were 5 minor complications in the ASC cohort including 2 stitch abscesses/superficial infections, 2 cases of arthrofibrosis, and 1 patient with mild asymptomatic anterior subluxation. There were 4 minor complications in the hospital cohort including stitch abscess/superficial infection, mild asymptomatic anterior subluxation, transient superficial radial nerve neuritis, and superficial vein thrombosis. The rate of complications was not statistically significant between groups. There were no cardiopulmonary complications in either group. The average total charge for the ASC cohort was $45,639.77.

CONCLUSIONS: This study demonstrates that TSA performed in the outpatient ASC setting is a safe alternative to hospital admission in appropriately selected patients. Further, outpatient TSA results in an average total charge that compares favorably with inpatient TSA charges reported in the literature. Further investigation is warranted to evaluate the longer term outcomes and cost-effectiveness of TSA performed on an outpatient basis.

The Relationship Between HgA1c and the Incidence of Adhesive Capsulitis

Abstract ID: Paper 216

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INTRODUCTION: While the association between diabetes and the incidence of adhesive capsulitis has been well documented, a relationship between HgA1c and adhesive capsulitis has not previously been established. However, HgA1c is only a measure of short-term blood sugar control. We believe that the incidence of adhesive capsulitis is associated with long-term cumulative blood sugar control, a relationship we seek to define using each patient's body of HgA1c values over time.

METHODS: A retrospective chart review of all patients evaluated at a single institution from 2001-2014 with at least 3 or more recorded HgA1c values was performed. Exclusion criteria included age < 18 and patients with HgA1c values only within a one-year span. A total of 24,417 patients met inclusion criteria. HgA1c values with date collected, body mass index (BMI), and hypothyroidism status were collected for each patient. A variable was created establishing the cumulative magnitude of abnormal HgA1c values over time, termed "cumulative HgA1c". A univariate and multivariate logit regression analysis were performed to determine the association between the cumulative HgA1c and the incidence of adhesive capsulitis.

RESULTS: Cumulative HgA1c was associated with the incidence of adhesive capsulitis (odds ratio 1.03, 95% CI 1.010 to 1.041, $p< 0.001$). For each year that HgA1c was abnormal, and each unit that HgA1c > 7, there was a 3% increase in the risk of adhesive capsulitis. The incidence of adhesive capsulitis was not associated with hypothyroidism ($p=0.637$) or BMI ($p=0.943$).

DISCUSSION: Cumulative HgA1c, our surrogate for the long-term cumulative blood sugar control, is associated with an increased incidence of adhesive capsulitis. This suggests that the effects of diabetes that predispose the development of adhesive capsulitis are dose-dependent. Patients with worse blood sugar control over a longer time period are at an increased risk of developing adhesive capsulitis.

Clinical Outcomes of Reverse Shoulder Arthroplasty in Patients 65 Years of Age or Younger

Abstract ID: Paper 217

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BACKGROUND: Reverse Shoulder Arthroplasty has classically been reserved for patients older than 65 with rotator cuff arthropathy and severe pain. In recent years, younger patients are increasingly offered RSA despite the paucity of literature regarding long-term outcomes in this population. This investigation assessed outcomes in a consecutive series of patients 65 and younger undergoing RSA.

METHODS: We identified 62 patients (64 shoulders) meeting our inclusion criteria with a minimum 2-year follow-up (mean 3.2 years, range 2.0-7.9). The average age of these patients was 60 (50-65) years at the time of surgery. Indications for surgery were cuff tear arthropathy (CTA) in 50 shoulders, severe glenohumeral arthritis in 17 shoulders, and avascular necrosis in 1 shoulder. There were 39 women and 25 men included in the study. The mean ages for women (60, range 50-65) and men (60, range 52-65) were not significantly different. The primary endpoint was revision free implant survival. Also studied were patient pain scale, range of motion, abduction strength, and radiographic analysis for loosening or notching.

RESULTS: The 2- and 5-year overall survival following RSA in patients younger than 65 was 98%. Clinically, there was a significant improvement in pain score (4.0 vs. 2.0, $p<0.0001$) on a 1 to 5 scale, active abduction (57.5° vs. 132.4°, $p<0.0001$), active external rotation (20.1° vs. 39.4°, $p<0.001$), and abduction strength (3.6 vs. 4.2, $p<0.0001$) on a 1 to 5 scale. At most recent follow-up, 90% of patients were satisfied with their result, and 85% of patients felt they were better or much better than before surgery. There was a 9% incidence of radiographic notching, 3% incidence of postoperative dislocation, and no cases of loosening.

CONCLUSIONS: At both the 2- and 5-year time points, RSA is a reliable operation in patients under 65 years old. Patients gain significant improvements in terms of pain level, range of motion, and strength without a large number of early failures. More research is needed to determine how these patients fare in longer term follow-up.

Accuracy of the Subchondral Smile and Surface Referencing Techniques in Reverse Shoulder Arthroplasty

Abstract ID: Paper 218

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INTRODUCTION: Inferior glenoid baseplate tilt relative to the coronal axis of the scapular body has been associated with improved results and fewer postoperative complications in reverse shoulder arthroplasty. However, the native glenoid surface is not always a reliable reference for the true scapular axis on which the prior glenosphere placement optimization studies were predicated. Digital preoperative planning software and advanced imaging now allow the surgeon to more precisely determine optimal glenoid placement customized to each individual patient's anatomy and in reference to the scapular axis. The purpose of this study was to evaluate accuracy of the subchondral smile and cannulated surface guide techniques in achieving inferior glenoid baseplate tilt by utilizing three-dimensional preoperative planning software.

METHODS: Virtual glenoid baseplate preparation and implantation was performed using the computed topography scans of 16 rotator cuff deficient shoulders. Two techniques were utilized: a subchondral smile technique that preferentially reams the interior glenoid resulting the appearance of a “smile,” and a cannulated surface guide technique that references the native glenoid face in order to place the baseplate in 10° of inferior tilt. After virtual implantation by both methods, the resultant baseplate coronal tilt relative to the tranverse scapular axis, baseplate coronal tilt relative to the native glenoid surface, maximal reaming depth, and percent of final baseplate seating were analyzed.

RESULTS: Using the 10° surface guide technique, the glenoid baseplate was implanted at a mean of 2.8° of superior tilt relative to the scapular axis. Using the subchondral smile technique, the glenoid baseplate was implanted at a mean of 8.9° of superior tilt, with a statistically significant difference between the two methods ($p=0.016$). Maximal reaming depth was 7.33 mm for the surface guide technique and 5.33 mm for the subchondral smile technique ($p<0.001$).

CONCLUSION: Neither the subchondral smile technique, nor a 10° cannulated surface guide technique are reliable methods to produce inferior glenoid tilt relative to the transverse axis of the scapula. The mean glenoid baseplate position was, therefore, superiorly inclined for both methods, which would be considered poorly positioned from our current understanding of optimal glenoid inclination. Surgeons should not rely on generic surface guides or the subchondral smile method alone in order to avoid superior baseplate tilt and negative consequences with which it has been associated. Three-dimensional preoperative planning software is a useful tool when attempting to achieve optimal glenoid baseplate positioning in reverse shoulder arthroplasty.

Scapular Notching in Revision Reverse Total Shoulder Arthroplasty

Abstract ID: Paper 219

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BACKGROUND: Scapular notching is a well-known complication of reverse total shoulder arthroplasty (RTSA) and has been associated with instability and decreases in patient satisfaction, range of motion, and functional outcomes. The rate of scapular notching in primary RTSA has been well studied. But it is unknown what the rate and severity of notching are in revision RTSA. The primary goal of this study was to examine this rate and compare it to that observed in primary RTSA. Additionally, a secondary goal was to evaluate the effect of glenosphere offset on notching rate in the revision setting.

METHODS: We evaluated 62 primary and 21 revision RTSAs performed by a single surgeon with a minimum of one year radiographic follow-up. Indications for primary RTSA included cuff tear arthropathy, capsulorraphy arthropathy, acute proximal humerus fracture, post-traumatic arthropathy, proximal humerus nonunion, rheumatoid arthritis, and osteoarthritis. Revision was defined as a shoulder with previous extensive open surgery, including fracture fixation and arthroplasty. Shoulders having only undergone prior arthroscopy, open rotator cuff repair, and open instability surgery were excluded. The most recent anteroposterior radiographs were evaluated with the Nerot-Sirveaux grading system for notching severity and the position of glenosphere offset was noted as inferior, standard, or superior. Rates of notching were compared using the Pearson chi-square test.

RESULTS: Notching occurred in 11 of 62 (18%) primary RTSAs compared to 9 of 21 (43%) revision cases (p=.03). Inferior glenosphere position was associated with notching in 5 of 41 (12%) primary cases and in 5 of 11 (45%) revision cases (p=.006). In primary RTSA, the notching rate was 12% (5/41) for inferior glenosphere offset and 29% (6/21) for standard and superior offset configurations (p=0.11). In the revision setting, the notching rate for inferior glenosphere offset was 45% (5/11), while standard and superior offset constructs demonstrated notching in 4 of 10 (40%) cases (p=0.80). Of the 20 shoulders with radiographic notching, 16 were grade I, 2 were grade II, and 2 were grade III.

CONCLUSION: Scapular notching is significantly more common in revision RTSA than the primary setting, even when inferior offset glenosphere configurations are compared. The more complex pathoanatomy, including soft tissue scarring and glenoid bone loss that can constrict options for glenosphere placement, may play a role in the higher rate of notching in these revision cases. An inferiorly offset glenosphere reduced the rate of scapular notching in primary RTSA, but was not protective in revision cases.

The Effect of HgbA1C on Acute Postoperative Total Shoulder Arthroplasty Infections

Abstract ID: Paper 220

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INTRODUCTION: Total shoulder arthroplasty (TSA) is an increasingly common treatment for various orthopedic conditions. While the rate of infection is relatively low, limiting the number of infections and stratifying patients' risk for infection will become more significant systemically as more total shoulder arthroplasties are performed. Patients with poorly controlled diabetes mellitus (DM) are also known to be at an increased risk for postoperative infection. The aim of this study was to evaluate how the rate of postoperative infections following TSA changes with increasing HbA1c levels.

METHODS: A software platform was utilized to investigate a multicenter database of pooled electronic medical records of over 50 million patients from 26 U.S. healthcare networks. A cohort of healthy patients that had undergone total shoulder arthroplasty was created, and the incidence of 30-day postoperative infections was calculated. This group was compared to cohorts of diabetic patients who underwent total shoulder arthroplasty with hemoglobin A1c <7%, 7-9.9%, and >10%.

RESULTS: There were 35,700 patients in the total shoulder arthroplasty patient cohort and 12,370 of these patients had HbA1c measurements. Overall, patients with diabetes had an increased risk of developing postoperative infection (1.21% vs. 0.69%). Within this cohort, their risk correlated to their HbA1c levels. Patients with HbA1c under 7.0% were found to have a postoperative infection risk of 1.14% with an associated relative risk of 1.65 (p=0.0001, 95% CI 1.29-2.11). When HbA1c was 7-9.9%, patients' risk increased to 1.38% with an associated relative risk of 2.00 (p=0.0001, 95% CI 1.42-2.83). As a patient's diabetes became uncontrolled with HbA1c levels surpassing 10%, postoperative infection rates rose to 1.49% with an associated relative risk of 2.16 (p=0.0174, 95% CI 1.14-4.07).

CONCLUSION: As a patient's hemoglobin A1c levels increase, their relative risk of postoperative infection following total shoulder arthroplasty increases. This suggest that surgeons should be aware of their patient's preoperative hemoglobin A1c and those with elevated levels may need optimized management prior to an elective TSA.

Low Complication Rate and Excellent Clinical Outcomes of Primary Reverse Total Shoulder Arthroplasty in Patients With a History of Glenohumeral Instability

Abstract ID: Paper 221

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INTRODUCTION: Proper soft tissue balance is paramount to maintaining stability and a functional arc of motion in shoulder arthroplasty. Patients with a prior history of glenohumeral instability are at a higher risk of failure with anatomic shoulder arthroplasties due to their compromised soft-tissues and imbalance. While the reverse prosthesis is designed to compensate for soft tissue deficiency, its outcome in this particular condition has not been studied specifically. The purpose of this study was to determine the clinical outcomes, revisions, and complications of reverse total shoulder arthroplasty (RTSA) in patients with a history of glenohumeral instability.

METHODS: 24 patients with a history of dislocation and instability that underwent primary RTSA from 2007 to 2013 were retrospectively reviewed. Their mean age was 70 years and their mean BMI was 30 kg/m^2. Eight patients (33%) had complete subscapularis deficiency, and seven patients (29%) had partial deficiency. The mean clinical follow-up was 2.4 years.

RESULTS: 22 patients (92%) had little to no pain at final follow-up. Mean shoulder abduction improved from 48.2° preoperatively to 120° postoperatively ($p<0.001$). Mean external rotation increased from 13.2° preoperatively to 47.5° postoperatively ($p<0.001$). Mean increase in abduction and external rotation was 73.4° and 33.9°, respectively. No patients experienced a postoperative dislocation at final follow-up. One patient (4.2%) underwent revision to a hemiarthroplasty for glenoid loosening at 3 months; there were no other revisions for any indication. There was no radiographic evidence of glenoid or humeral loosening; 3 shoulders (12.5%) had evidence of scapular notching.

CONCLUSION: Reverse shoulder arthroplasty is a successful procedure for patients with glenohumeral osteoarthritis and poor soft tissues secondary to prior glenohumeral instability. Postoperative instability was not identified as a major failure mode despite the high rate of soft-tissue deficiencies, including subscapularis insufficiency in the large majority of shoulders.

SUMMARY: Reverse shoulder arthroplasty results in excellent clinical outcomes and a low complication rate without evidence of a substantial rate of postoperative instability.

Shoulder Arthroplasty for Chondrolysis

Abstract ID: Paper 222

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INTRODUCTION: Chondrolysis is a rare complication after shoulder arthroscopy leading to early joint destruction. Not uncommonly, patients with chondrolysis are relatively young and develop cartilage loss on both the humeral head and the glenoid. Shoulder arthroplasty may be considered for end-stage chondrolysis, but concerns exist about implant survivorship in this population as well as the possibility that some cases could represent a low-grade infection. This study aims to assess pain relief, function, and survivorship of shoulder arthroplasty for chondrolysis, and assess risk factors for failure.

METHODS: Between January 2000 and January 2013, 26 consecutive shoulders with chondrolysis were treated at our institution with shoulder arthroplasty. All shoulders had a prior arthroscopic procedure that predated a phase of rapid joint destruction. Twenty-three shoulders were followed for a minimum of 2 years (mean, 4.0 years; range 0.7 – 8.6 years) or until the time of his study. The mean age of the patients was 40 years (range 21-58 years). Outcome measures included pain, range of motion, postoperative modified Neer ratings, ASES scores, complications, and reoperations.

RESULTS: At most recent follow-up, 14 of the 23 shoulders had no or mild pain. Overall pain scores improved from 4.7 to 2.6 points ($p<.001$). Subjectively, eight patients rated their shoulder as much better, 7 as better, 4 the same, and 4 worse. Abduction and external rotation improved significantly ($p=0.012$, $p=0.016$). Five shoulders required re-operation, two for glenoid loosening and one each for infection, instability, and stiffness. Most recent ASES scores averaged 64 points (range 20-95 points). There were a total of 6 excellent, 8 satisfactory, and 9 unsatisfactory results based on modified Neer ratings.

CONCLUSION: Shoulder arthroplasty for the treatment of chondrolysis provides improved pain and range of motion in many patients. However, patient satisfaction is variable. Early follow-up also shows a higher than expected rate of reoperation (25%). Patients undergoing shoulder arthroplasty for chondrolysis should be counseled appropriately regarding expectations following surgery.

MAOA BREAKOUT SESSION #15
TRAUMA/OTHER
April 16, 2016

Orthopedic Surgery in Patients With Concurrent Liver Disease

Abstract ID: Paper 223

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INTRODUCTION: Liver cirrhosis and its complications are the 12th leading cause of death in the U.S. Little information exists within the orthopedic literature that examines the operative risks associated with patients who have liver disease. Scoring systems have been developed to assess preoperative liver dysfunction and to predict outcomes following surgery. The Model for End-Stage Liver Disease (MELD) score is one such system. This system uses serum creatinine and bilirubin concentrations as well as the INR to create a numerical score. We propose that the MELD score can be applied to orthopedic patients with liver disease undergoing surgery to predict perioperative complications.

METHODS: Patients having orthopedic surgical procedures at a Level 1 Trauma Center within the past 10 years were identified using ICD-9 codes for hepatitis and cirrhosis. We included both trauma patients and elective orthopedic cases for comparison. Patient demographics, alcohol use, smoking status, type of liver disease, and type of surgical procedure were recorded. A MELD score was computed for each patient. Laboratory values, readmissions, and hospital stay were also recorded. Perioperative complications were assessed. Chi-squared and t-test were employed for analysis. Statistical significance was set at $p \leq 0.05$.

RESULTS: 204 patients were identified who had undergone orthopedic surgery with concurrent liver disease. The 75 with complete data represented our study group. 37 (49%) were trauma patients. The remainder underwent planned procedures. The average age of the patients was 58 years old (range: 26-78), 47 (63%) were male, 45 (60%) were Caucasian and 12 (16%) African American, 33 (44%) were smokers, and 30 (40%) reported using alcohol. Complications occurred in 12 (16%) patients, and the most common complication was poor wound healing. The mean length of stay for complicated patients was 17.6±15.1 days. There was no statistically significant difference between trauma and elective patient MELD scores. Patients with complications had a mean MELD score of 13.9±6.5, and patients without complications had a mean MELD score of 12.0±5.3. These differences were not statistically significant. Mean INR for complicated patients was 1.4±0.2, compared to 1.3±0.4 in non-complicated patients.

CONCLUSION: Patients with liver disease have a high complication rate and long hospital stays. The MELD score may be a systematic way to assess patients with liver disease. However, the MELD score was not a predictor of perioperative complications in orthopedic trauma and elective orthopedic surgery as it is in other surgical specialties.

Does Experience Affect Acetabular Fracture Reduction Quality?

Abstract ID: Paper 224

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INTRODUCTION: Improved reduction quality after surgical fixation of acetabular fractures is directly related to improved functional outcomes. Several studies document the existence of a "learning curve" when developing surgical skills. The purpose of this study was to assess reduction quality for a single surgeon series of acetabular fractures with particular emphasis on defining a relationship between surgeon experience and quality of reduction.

METHODS: This is a retrospective evaluation of a prospectively collected acetabular fracture database from a single, fellowship-trained surgeon at a level 1 trauma center. The quality of reduction of all acetabular fractures treated with open reduction internal fixation (ORIF) between September 2001 and December 2014 was assessed using postoperative radiographs. Anatomic, imperfect, and poor reductions were defined as a displacement of ≤1 mm, 2-3 mm, and >3 mm, respectively. Surgeon experience was defined as number of years in practice. A total of 788 acetabular fractures were treated during this period; 70 percutaneously-treated acetabular fractures were excluded. Outcome measurements included quality of reduction, blood loss (EBL), operating time, and complications as related to surgeon experience. The correlation between surgeon experience and outcome measurements was evaluated as a continuous variable using logistic regression analysis. A p value of 0.05 was considered statistically significant.

RESULTS: In total, 718 acetabular fractures met inclusion criteria (mean age 44 years, range 11-96; mean BMI 29.1, range 16.7-64.6). Mean EBL was 806 mLs (20-9600), and mean operative time was 219 minutes (38-850). Overall, anatomic reduction was achieved 84.3% of the time. No significant differences were found among years in regards to EBL or postoperative complications ($p>0.05$). Anatomic reduction percentage was directly correlated to years in practice, with a correlation coefficient of 0.792 ($p<0.001$). For each additional year of experience, the surgeon produced an average of 1.3% more anatomic reductions. Also, the rate of imperfect vs. poor reductions increased over time when reductions were non-anatomic ($p<0.05$). Operative time was negatively correlated to experience, with a correlation coefficient of -0.131 ($p<0.001$). On average, operative time decreased by 3.2 minutes with each subsequent year of experience.

CONCLUSION: Acetabular reduction quality is directly correlated with surgical experience, and operative time is inversely proportional to surgical experience. With each additional year of experience, the senior author produced on average 1.3% more anatomic reductions and was able to do so in 3.2 fewer minutes. Acetabular surgeons can expect improvements in reduction quality and operative time as they gain experience.

What is the Refracture Rate After a Fragility Fracture Following Bone Health Intervention in an Orthopedic Clinic?

Abstract ID: Paper 225

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INTRODUCTION: Fragility fractures are an epidemic problem. Rates of follow-up after a fragility fracture have been reported to be 10 to 20%. Increased risk of subsequent fracture can occur for ten years after the initial fragility fracture. Targeted intervention has been shown to reduce refracture rates in nonvertebral fractures. The purpose of this study was to identify the refracture incidence and describe the relationship between risk factor(s) and refracture.

METHODS: From one large orthopedic practice affiliated with a level 1 trauma center in an open system, 663 patients with fragility fractures were identified and followed for a minimum of two years. Bone Health was implemented to identify, evaluate, educate, and treat patients at risk for osteoporosis following a fragility fracture. System modifications included: coordination among the inpatient orthopedic unit, outpatient radiological and laboratory services, and orthopedic private practice clinic and occupational and physical therapy for a continuum of care. A nurse practitioner completed inpatient consultation and followed the patient outpatient for diagnosis, counseling, and treatment. Fracture location, osteoporosis risk factors, and subsequent fractures were assessed.

RESULTS: Average age at initial fragility fracture was 72 (range 24-99) among primarily females (511, 77.1%). Fragility fractures occurred in the spine (293, 44.2%), hip (134, 20.2%), tibia/fibula/ankle (66, 10.0%), distal radius (50, 7.5%), pelvis/sacral (48, 7.2%), proximal humerus (38, 5.7%), and other (39, 5.9%). T-score femoral neck was -2.4 (range -7.9 – 1.5, SD .93) and lumbar spine -2.0 (range -5.3 – 4.0, SD 1.4). Tobacco use included 68 (10.3%) current smokers, 173 (26.1%) former smokers, and 422 (63.7%) nonsmokers. Excessive alcohol intake occurred in 32 (4.8%). 100% received calcium and Vitamin D supplementation recommendations based on laboratory results. Prescriptive osteoporosis treatment consisted of teriparatide followed by bisphosphonate or Denosumab in 556 (83.9%), Denosumab 9 (1.4%), bisphosphonate 6 (0.9%), raloxifene 2 (0.3%), and none 88 (13.3%). Subsequent fragility fractures occurred in 107 (16.1%) at an age of 75 (range 36-96). Subsequent fractures occurred primarily in the hip (25, 23.4%), spine (23, 21.5%), and distal radius (17, 15.9%). No deaths or cancer diagnosis occurred during the follow-up period.

CONCLUSION: Despite vigilant bone health intervention and follow-up, subsequent fractures, but no deaths or cancer diagnoses, occurred in 16% of those that had a previous fragility fracture. Coordinated, consistent bone health intervention is effective to improve bone quality.

Perioperative Complications Following Total Elbow Arthroplasty and Open Reduction and Internal Fixation of Distal Humerus Fractures in Patients Over 65 Years Old: A Nationwide Analysis

Abstract ID: Paper 226

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BACKGROUND: Total elbow arthroplasty (TEA) is increasingly used for patients who sustain a distal humerus fracture. We investigate the in-hospital perioperative complications and outcomes of patients who underwent a TEA and open reduction and internal fixation (ORIF) for distal humerus fractures.

METHODS: The Nationwide Inpatient Sample (NIS) database was queried from 2002-2011 for all patients ≥ 65 years old who underwent TEA (ICD-9 procedure code=81.84) or ORIF (ICD-9 procedure code=79.31) of distal humerus fractures. The NIS is a statistically representative sample of hospitals from across the United States that includes data on approximately 8 million inpatient admissions per year or roughly 20% of all admissions. A weighted sample of 3,268 patients underwent TEA and 25,765 patients who underwent ORIF during these 10 consecutive years. The demographic data, comorbidities, complications, and perioperative inpatient data were compared between the patient who underwent TEA and ORIF.

RESULTS: The average age of patients in this study was 78 years for each group. The perioperative rates of pneumonia (p=0.40), deep venous thrombosis (p=0.18), pulmonary embolism (p=0.44), myocardial infarction (p=0.94), urinary tract infection (p=0.32), hematoma (p=0.47), blood transfusions (p=0.85), and death (p=0.52) were not statistically different between groups. The mean length of stay was similar (p=0.22) between TEA (4.6 days) and ORIF (4.5 days) patients. Proportion of patients discharged home was also similar between groups. Hospitalization charges were significantly higher in the TEA group ($57,396 vs. 39,362 for ORIF, p<0.001). Patients who underwent TEA were more likely to be female (89.6% vs. 80.8% for ORIF, p<0.001) and more likely to be treated at a teaching hospital (62.6% vs. 40.5% for ORIF, p<0.001). The average number of pre-existing medical comorbidities was similar (1.8 each). After adjustment of demographic data and comorbidities, type of surgery was not independently associated with perioperative complication rates.

CONCLUSION: Female gender and teaching hospital status were associated with increased likelihood of a TEA for distal humerus fracture. After adjustment of differences in preoperative variables, hospitalization charges were significantly higher in the TEA group, but complication rates and length of hospital were similar.

Level of Evidence: Therapeutic Level III

Surgical Outcomes of Medial vs. Lateral Sided Injuries in the Dislocated Knee

Abstract ID: Paper 227

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(Presented by Matthew M. Crowe, M.D. / Rochester, MN)

INTRODUCTION: Knee dislocations are devastating injuries. While evidence exists for general outcomes of surgical reconstruction, there is currently a paucity of data specifically comparing outcomes of medial-based vs, lateral-based knee dislocations. The purpose of our study was to compare outcomes from surgically treated KDIII-M to KDIII-L knee dislocations.

METHODS: A retrospective review of the medical records of patients who presented with knee dislocations was conducted. We identified patients that underwent surgical treatment of KDIII-M (ACL/PCL/MCL) or KDIII-L (ACL/PCL/LCL) knee dislocation as documented by the Schenck classification. Minimum two-year follow-up with Lysholm and International Knee Documentation Committee (IKDC) outcome scores was required for inclusion. Data was analyzed using univariate statistical models with P-value < 0.05 considered significant.

RESULTS: A total of 56 patients met inclusion criteria and included 24 (43%) KDIII-M and 32 (57%) KDIII-L injury patterns with a mean age of 34 years (range, 16-62) and a mean follow-up of 6.5 years (range, 2-20 years). Twelve (38%) patients in our KDIII-L group had peroneal nerve injury. Three patients (25%) experienced a complete recovery, 6 (50%) had a partial recovery, and 3 (25%) demonstrated no recovery from peroneal nerve injury. Despite this, medial-sided injuries were associated with lower outcomes for both the Lysholm (64.7 vs. 77.0, P = 0.04) and IKDC (62.1 vs. 74.0, P=0.04) scoring systems. Additionally, medial-sided injuries experienced decreased range of motion postoperatively compared to lateral sided injuries (121° ± 15° vs. 128° ± 11°; P=0.04). Female sex was also linked to worse outcome for both groups (Lysholm: 58.8 ± 21.5 vs. 77.8 ± 21.1; P < 0.01 & IKDC: 54.9 ± 23.7 vs. 75.2 ± 20.2; P<0.01) as were repairs compared to reconstructions on the medial side (Lysholm: 46.4 ± 9.9 vs. 69.5 ± 20.6; P=0.04 & IKDC: 39.8 ± 16.7 vs. 68.0 ± 19.7; P=0.01). No differences in outcome were found between patients with and without peroneal nerve injury or repair vs. reconstruction in the KDIII-L group.

CONCLUSIONS: In patients undergoing multiligament knee reconstruction, our data suggests that patients with KDIII-M knee dislocations are not as likely to achieve positive results as patients with KDIII-L dislocations, regardless of the status of the peroneal nerve. Additionally, medial-sided repairs were inferior to reconstruction and overall, females showed decreased outcome compared to males. Further larger prospective studies are needed to identify the cause of the outcome disparity observed between these two groups after multi-ligament knee surgery.

Inpatient Admission for Fractures of the Proximal Humerus in Elderly Patients is Associated With Increased Mortality

Abstract ID: Paper 228

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INTRODUCTION: Our goal is to understand patient survival, ambulation, and independence following fractures of the proximal humerus in elderly based on admission status and treatment modality cohorts.

METHODS: We retrospectively reviewed 320 patients ≥65 years old treated at a level 1 trauma center for isolated fractures of the proximal humerus between 2006-2012. Patients were stratified into cohorts based on inpatient admission status and treatment method. The main outcome measure was two-year mortality. We used cox proportional hazards regression to compare two-year mortality among patients based on treatment method, inpatient admission, and discharge facility. Descriptive statistics were used to summarize the general makeup of our population as well as changes in independent living and ambulatory status post-fracture.

RESULTS: The two-year mortality of those initially admitted to inpatient from the emergency department was 28/118 (23.7%) compared to 25/202 (12.4%) of those managed outpatient. Those admitted had a higher mortality with a hazards ratio (HR) of 9.62 over two years (p=0.0421). Those who underwent operative intervention had a lower mortality (HR 0.0791; p=0.0233). Increased length of stay (LOS) was associated with a decrease in living independence at discharge. Fracture severity was correlated with admission and LOS, but not two-year mortality. Those discharged to a higher level of care had an increase in 2-year mortality at 33.7% compared to 5.7%. However, this was statistically insignificant (p=0.1109). At one-year, 15.6% lost at least one level of ambulatory independence and 11.2% lost at least one level in living dependence.

DISCUSSION AND CONCLUSION: Of patients >65 years old with isolated fractures of the proximal humerus, inpatient admission at the time of injury was associated with higher mortality while operative intervention was associated with a lower two-year mortality. Those admitted and managed non-operatively had the highest mortality and likely represent the frailest cohort while those initially managed outpatient who underwent surgery had the lowest mortality and likely represent a more fit population. This data helps stratify our patients at the time of injury and can aid in counseling and identifying higher care needs.

Treatment and Outcomes of Patients With Ipsilateral Acetabular and Femur Fractures

Abstract ID: Paper 229

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INTRODUCTION: The combination of ipsilateral acetabular and femur fractures are uncommon. Complications from this injury may include heterotopic ossification (HO), avascular necrosis (AVN), and post-traumatic arthritis (PTA). The goals are to investigate the outcomes and complications of a multi-center cohort of patients.

METHODS: We performed a retrospective review of patients with ipsilateral acetabular and femoral fractures (excluding femoral head). Injury data and surgical details were collected. The fractures were grouped according to Letournel for acetabular fractures and and proximal/shaft/distal for femur fractures. Nominal data was analyzed using Chi squared analysis or Fisher's exact test as appropriate. Categorical data was analyzed using Mann Whitney U-test. Analysis of variance (ANOVA) was performed to model combinations of variables.

RESULTS: 101 patients from 7 Level 1 trauma centers met inclusion criteria. There were 64 males and 37 females with an average age of 37 (range: 17-78). The average follow-up was 13 months. Eighty-seven (86%) patients were injured in either a motor vehicle or motorcycle crash. Fifty-four patients had elementary and 47 had associated/combined pattern acetabular fractures. There were 52 proximal, 41 shaft, and 8 distal femur fractures. Twenty-six patients underwent stabilization of both fractures during the same anesthetic. Sixteen patients underwent fixation of both fractures using the same incision. Seven patients (7%) had AVN, 29 (29%) had HO, 18 (18%) had PTA, and 14 (14%) had DVT/PE. There were 9 superficial and 8 deep infections, resulting in an aggregate rate of 17%. Sixteen patients required additional surgery on their acetabular fracture, 12 required additional surgery on their femur, and 2 required additional surgery at both sites. The rate of infection, AVN, and HO were significantly higher in the combined acetabular fractures with proximal femur fractures ($p<0.05$). The rate of DVT /PE in femoral shaft fractures with acetabular fractures was significantly higher ($p<0.05$).

CONCLUSION: This is the first study to report the results of surgical treatment of ipsilateral acetabular and femoral fractures. In this cohort, surgical timing, approach, and implants for fracture fixation had no impact upon the complication rate. We found the complication rates for infection, AVN, and HO to be significantly higher when the associated acetabular fractures coexist in the same region. In addition, a femoral shaft fracture with an acetabular fracture had the highest rate of DVT/PE-well above established norms for either fracture alone. This study provides useful information regarding the prognosis and outcome of patients with this injury complex.

Articular Step Off is a Better Predictor of Meniscus Injury Compared to Tibial Plateau Widening in Lateral Tibial Plateau Fracture

Abstract ID: Paper 230

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INTRODUCTION: Meniscal injury is common after tibial plateau fracture. The purpose of this study was to compare the predictive value of articular impaction and tibial plateau widening on lateral meniscal injury in tibial plateau fractures, as visualized on preoperative radiographs and CT images.

METHODS: We retrospectively reviewed consecutive patients with lateral tibial plateau fractures that required operative intervention. All patients had an arthrotomy at the time of articular reconstruction to evaluate for meniscus integrity. Preoperative radiographs and CT scans were routinely obtained for surgical planning. Images were reviewed and analyzed for specific parameters. Proximal tibia width (TW) and lateral tibial plateau width (LW) were measured on plain radiograph and maximum articular impaction/displacement was measured on CT scan (Image-1). Demographic, intraoperative data, requirement for bone graft, and preoperative imaging data were analyzed.

RESULTS: Seventy patients with complete data points were included in the study. Mean age was 45.1(±12.9) years. Twenty-two patients had meniscus injury (MI) and 48 patients did not (NMI). Twelve had Schatzker type I and 58 had type II fractures. Patients with meniscus injury were more likely to require bone graft compared to those with no meniscus injury, 95.5% vs. 54.5%, respectively ($p=0.001$). TW was (92 mm ± 9.4 mm) in NMI and (93.7 mm ± 10.5mm) in MI groups ($p=0.36$). LW was (43.8 mm ± 6.36 mm) in NMI and (45.2 mm ± 6.7 mm) in MI ($p=0.48$). Mean articular impaction (AI) was (6.4 mm ± 4.3 mm) in NMI and (12.48 mm ± 7.17 mm) in MI group ($p<0.01$). Logistic regression revealed that AI is the only predictive factor for meniscus injury and for every 1 mm increase in AI, there is a 21% increase chance of meniscus tear ($p<0.01$). Using Receiver operating characteristic (ROC) analysis, the area under ROC curve increased by only 1% with inclusion of TW and LW.

CONCLUSION: There is no difference between TW and LW in MI group compared to NMI group. Patients with meniscal tear had a higher degree of AI. AI is the only predicting factor for meniscus injury. Patients with meniscus injury were more likely to require bone grafting. These values are useful for preoperative planning and in predicting preoperative meniscal tear without the use of an MRI.

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Open Tibia Fractures in a Rural Setting: Does Evaluation at an Outside Hospital Increase the Risk of Infection?

Abstract ID: Paper 231

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PURPOSE: To determine if patients with an open tibia fracture in a rural setting have a higher infection rate if they initially present to an outside hospital and then transferred to the regional ACS level 1 trauma center vs. those that initially present to the ACS level 1 trauma center.

HYPOTHESIS: Since we have longer transit times than previously published urban definitive care centers, those patients that go directly to the ACS level 1 trauma center with an open tibia fracture should have a lower deep infection rate due to less delay in operative debridement.

METHODS: After IRB approval, a retrospective chart review of 164 patients with open tibia fractures (from plateau to pilon) seen at an ACS level 1 trauma center (definitive care center) was performed. The standard of care included administration of antibiotics and tetanus prophylaxis upon presentation, debridement of wounds, and primary or staged stabilization of the fracture or amputation. The primary outcome was incidence of deep infection. The definition of deep infection was fractures that required operative debridement. The secondary outcome was the incidence of superficial infection. Superficial infection was defined as those fractures that were managed with local wound care with or without antibiotics.

RESULTS: A total of 143 patients representing 151 fractures met the inclusion criteria. Nineteen fractures in the outside hospital group and 21 fractures in the definitive care center group developed a deep infection. There was no statistically significant ($p=0.39$) difference between the two groups. The secondary endpoint of superficial infection was significantly higher ($p=0.01$) in those fractures in the outside hospital group.

CONCLUSIONS: In a rural setting, patients with an open tibia fracture that are initially seen at an outside hospital do not appear to have a higher risk of deep infection when compared to those that go directly to the definitive care trauma center. However, they do appear to have a significantly higher risk of developing a superficial infection.

Risk Factors for Neurovascular Injury Associated With Knee Dislocations

Abstract ID: Paper 232

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INTRODUCTION: We examined risk factors of sustaining concomitant neurovascular injury and a knee dislocation without an associated lower extremity fractures using a national trauma database.

METHODS: The American College of Surgeons National Trauma Data Bank (NTDB) was queried from 2010-2012 to identify patients who sustained a knee dislocation using International Classification of Diseases, Ninth Revision (ICD-9) codes (836.50-54, 836.59, 836.60-64, 836.69). The NTDB is the largest aggregation of U.S./Canadian trauma registry data ever assembled, with over 6 million records from hundreds of facilities. We included patients 18 to 64 years of age with a Glasgow Coma Scale score of 12 or higher. We evaluated demographic and clinical variables including sex, age, race, obesity (defined as BMI ≥ 30), smoking status, hypertension, and diabetes. Variables that were significantly different between patients with and without a nerve or vessel injury in univariate analyses were incorporated into multivariate analyses to adjust for confounders. Univariate and multivariate data analysis was performed on the cohort of patients sustaining a knee dislocation without a lower extremity fracture.

RESULTS: There were a total of 2797 patients from this database who sustained knee dislocations during three consecutive years. 1344 of these patients did not have an associated lower extremity fracture. A nerve injury was present in 78 of 1453 (5.4%) and 57 of 1344 (4.2%) patients with and without a fracture, respectively. A vessel injury was present in 197 of 1453 (13.6%) and 202 of 1344 (15.0%) patients with and without a fracture, respectively. After univariate analyses, we found that obesity was associated with a higher rate of nerve and vessel injury (p-value of .04 and <.01, respectively). Smoking and hypertension were associated with a higher rate of vessel injury (p-value of .02 and .02, respectively). After multivariate regression analyses, obesity was independently associated with higher rates of concomitant nerve injury (odds ratio [OR]=2.5, 95% confidence interval [CI]=1.2-5.2), and vessel injury (OR=2.5, 95% CI=1.7-3.8). Smoking, hypertension, and diabetes were not significantly associated with neurovascular injury after a knee dislocation.

DISCUSSION AND CONCLUSION: The rate of concomitant nerve or vessel injury in a patient sustaining a knee dislocation without associated fracture was 4.2% and 15%, respectively in this study. Among patients sustaining knee dislocations without a fracture, obesity is an independent risk factor for concomitant neurovascular injury.

The Anabolic Effects of Electrical Stimulation on Endochondral Bone Formation

Abstract ID: Paper 233

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INTRODUCTION: Electrical stimulation (ES) is used to treat nonunion fractures and enhance spinal fusion rates. Its effects on endochondral ossification have been studied both in vitro and in vivo with evidence that it is capable of both inhibitory or stimulatory effects. Literature on its mechanism, however, is limited. The purpose of this study is to determine what effects direct current (DC) and capacitive coupling (CC) have on endochondral ossification and examine their mechanisms.

METHODS: Thirty-four femurs from 3-week-old C57BLK6 mice were divided into 3 groups (DC, CC, and control) and maintained in culture. After 2 days, the femurs were transferred daily to a silicone chamber with saline. The DC and CC group received 10 minutes of DC at 10V and CC at 10VPP/16Hz, respectively; the control group received no current. After 7 days in culture, all specimens were either prepared for micro-computed tomography (μCT) analysis and histomorphometry, or frozen immediately for gene expression analysis using quantitative polymerase chain reaction (qPCR). Each ES was compared to the control using parametric non-paired t-test with $p<0.05$ considered significant.

RESULTS: Both DC and CC treatments exhibited significantly increased bone volume/tissue volume and bone area compared to control. The DC group additionally had significantly increased trabecular thickness while the CC group had a significant increase in the trabecular number and decrease in the trabecular spacing. Histomorphometric analysis of von Kossa-stained specimens demonstrated a significant increase in resting/proliferative zones and decrease in hypertrophic zones in both the DC and CC groups compared to the control. On Safranin O-stained sections, there was deeper staining and an increased area of red in the sub-epiphyseal spongiosa in both DC and CC specimens compared to control. Mason's trichrome-stained sections showed a significant increase in the osteoid area/bone area in both DC and CC groups compared to the control. Analysis of qPCR data demonstrated that DC stimulation significantly increased expression of alkaline phosphatase (ALP) and type I collagen (Col1) while CC stimulation dramatically increased expression of ALP, Sox9, and type X collagen (Col10).

CONCLUSION: This study corroborates previous evidence that ES is capable of stimulating endochondral bone formation. The variances in results between DC and CC, however, suggest they work through distinct mechanisms. The increase in trabecular thickness and Col1 may indicate that DC functions through an osteogenic pathway while the increase in trabecular number, Sox9, and Col10 expression in CC stimulation may indicate it functions through a chondrogenic pathway.

Reliability Testing of the Larsen and Sharp Classification Systems for Rheumatoid Arthritis of the Elbow

Abstract ID: Paper 234

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INTRODUCTION: Multiple classification systems have been proposed to radiographically assess patients with rheumatoid arthritis (RA) affecting the elbow, with two of the most popular being the Larsen and Sharp schemes. To our knowledge, no study has investigated the reliability of these two systems. We proposed to evaluate and compare the intra- and inter-observer agreement of the Larsen and Sharp systems to determine if one of them is more reliable.

MATERIALS AND METHODS: The radiographs of 45 patients diagnosed at our institution with rheumatoid arthritis affecting the elbow were evaluated. Anteroposterior and lateral radiographs of each elbow were de-identified and distributed to 6 evaluators (4 fellowship-trained upper extremity surgeons and 2 orthopedic trainees). Each evaluator graded all 45 radiographs according to the Larsen and Sharp scoring methods on 2 occasions, at least 2 weeks apart.

Intra- and inter-observer reliability were calculated using weighted Conger's Kappa and Spearman’s correlation coefficients with 95% confidence intervals (CI). Calculations were performed for overall intra- and inter-observer reliability and also based on level of training. Reliability scores greater than 0.8 were considered to indicate substantial agreement and values between 0.6-0.8 good agreement. Two-tailed t-tests were used to evaluate differences in agreement scores between scoring systems and between attending surgeons and trainees. Statistical significance was set at $p<0.05$.

RESULTS: Mean overall intra-observer reliability was 0.93 (CI 0.90-0.95) for the Larsen system and 0.92 (CI 0.86-0.96) for the Sharp classification, both indicating substantial agreement. Average overall inter-observer reliability was 0.70 (CI 0.60-0.80) for the Larsen classification and 0.68 (CI 0.54-0.81) for the Sharp system, both indicating good agreement. There were no significant differences in the intra- or inter-observer reliability of the systems overall. And there were also no significant differences in reliability between attending surgeons and trainees for either classification system.

CONCLUSION: The Larsen and Sharp systems both show substantial intra-observer reliability and good inter-observer agreement for the radiographic classification of rheumatoid arthritis affecting the elbow. Differences in training level did not result in substantial variances in reliability for either system. We conclude that both systems can reliably be used to evaluate rheumatoid arthritis of the elbow by observers of varying training levels.

Relationship Between Bone Turnover Markers and Bone Mineral Density After Two Years of Teriparatide Prior to Secondary Therapy

Abstract ID: Paper 235

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INTRODUCTION: Teriparatide has been shown to increase bone turnover, bone formation, and bone density as measured by bone mineral density (BMD) scans and bone turnover markers (BTMs). Specifically, N-terminal propeptide of type-1 collagen (P1NP) and C-terminal telopeptide (CTX) measure bone formation activity and bone resorption, respectively. There is a paucity of evidence to identify the most efficacious drug at maintaining the benefits of teriparatide. Before this can be determined, the effect of teriparatide on BTMs and BMD must be determined. The purpose of this study was to evaluate the BTM and BMD changes and relationship prior to initiating secondary therapy.

METHODS: From one Bone Health Clinic affiliated with a Level 1 trauma center, 108 patients with fragility fractures treated with teriparatide were identified from an electronic medical record from 2009-2012. 21 patients were excluded due to insufficient laboratory data; leaving a study sample of 87 patients (predominantly female, 69, 79.3%), average age 69 (38-91) for a retrospective analysis of BTMs and BMD. BTMs were evaluated at baseline, 3 months, 1 year, and 2 years. BMD was evaluated at baseline and 2 years.

RESULTS: The BMD t-score had a significant change between baseline and 2 year follow-up with a mean increase in t-score by 0.43 ($p<0.001$). The mean serum CTX was 0.45 ng/mL, 0.74 ng/mL, 0.85 ng/mL, 0.67 ng/mL at each time interval, respectively. The serum CTX demonstrated a significant difference from baseline to 2 years from initiation of teriparatide ($p<.001$). The mean serum P1NP was 57.6 ng/mL, 138.09 ng/mL, 156.15 ng/mL, 102.99 ng/mL at each time interval, respectively. The serum P1NP demonstrated a significant difference from baseline to 2 years from initiation of teriparatide ($p<.001$). Furthermore, a Pearson Correlation displayed a significant relationship between overall change in P1NP and BMD t-score ($r=0.230$; $p=.032$) and between overall change in CTX and BMD t-score ($r=0.253$; $p=.018$).

CONCLUSION: Modeling and remodeling bone was demonstrated with significant changes in BTMs and BMD over two year administration of teriparatide. Prior to administering secondary therapy, BTMs have begun to decrease from their maximum value and demonstrate a significant linear relationship with BMD. Both serum P1NP and serum CTX are shown to be possible proxies for BMD in determining efficacy of secondary treatment following teriparatide in maintaining BMD.

How Do Patients Determine Physician Satisfaction Rates: A Prospective Survey Study

Abstract ID: Paper 236

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INTRODUCTION: In recent years, there has been increased attention paid to patient satisfaction and subjective outcomes in regards to pay for performance models and online physician rating sites. Understanding details that provide a higher percentage of “satisfied” patients is important in the modern healthcare environment; particularly with the reimbursement scrutiny surrounding elective procedures like hip and knee arthroplasty. The purpose of this study was to determine factors that patients deem important when evaluating their orthopedist.

METHODS: Following IRB approval, we prospectively surveyed 212 patients in an adult reconstruction clinic using a newly developed, self-administered computer questionnaire and an independent third party survey center devoid of any identifying data. The survey was offered to all patients seen in clinic either before or after their visit.

RESULTS: 194/212 patients completed all required questions. When asked how much time they would like to spend with the doctor on a routine visit, 10-15 minutes was the most common response (44.32%), with only 7.2% patients desiring >20 minutes. 92.7% reported being satisfied with the time the physician spent with them. 41.7%, the most common response, reported a wait time of 30 minutes as too long. If seen only by a physician’s assistant or nurse practitioner at a follow-up visit, 37.1% stated they would feel as though they were receiving below average care. All but one patient reported that if they needed a major surgery they would want to know what the physician would do in their position. 2.6% of patients preferred a physician of the same race/ethnicity. Male orthopedic surgeons were preferred by 15.5% of patients while female orthopedic surgeons were preferred by 8.2%. When asked of preference of physician’s age, 44.3% reported no preference; while the remaining preferred a physician between 35 and 55. Recommendations from friends or other physicians account for over 75% of how patients find their physician, with only 2.5% of patients reporting advertising as the reason.

CONCLUSIONS: Many patients have an ideal physician in regards to age and nearly 1 in 4 patients have a gender preference when selecting an orthopedist. A large number of patients may report lower satisfaction if not seen by the physician on follow-up visits. Satisfied patients as well as their primary care physicians play a critical role in referrals. Diminishing clinic wait times (or making this time more palatable) and understanding patient preferences may lead to a greater percentage of “satisfied” patients.

Accidental Firearm Injuries Prevalent During Hunting Season: Trends in Firearm Injuries Over 12 Years at a Rural Level 1 Trauma Center

Abstract ID: Paper 237

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BACKGROUND/PURPOSE: Recently firearm injuries in the United States have taken center stage in political debates and in the media. This discussion often focuses on violent crimes and law enforcement, but fails to highlight accidental injuries often seen in a rural orthopedic practice. This study was undertaken to highlight the unique set of firearm injury data gathered at a rural level 1 trauma center; thus, providing insight into prevalence, mechanism of injury, and seasonal variation. Our goal is to identify characteristics of preventable firearm injuries to guide public health officials to prevent these potentially devastating injuries through education and public policy.

METHODS: An IRB-approved retrospective study was performed of the trauma registry at a rural Level 1 hospital to identify all patients with all firearm injuries from January 2002 to May 2014. Data obtained for each patient included demographics, injury date, a brief injury summary, Injury Severity Score (ISS), and results of drug/alcohol screenings. Associated comorbidities and complications were also captured to provide insight into factors that could result in a higher cost, longer hospital stay, or worse clinical outcome. Chart review was performed to confirm accuracy of the database.

RESULTS: During the 12-year-period ranging from January 2002 to May 2014, 408 patients with firearm injuries were treated at our hospital. There were 352 (86%) males and 56 (14%) females. Ages ranged from an infant to 90 years. Mortality in this series was 19%. The median age for fatal wounds was 44 years, with the median age for non-fatal wounds was 27 years. The cause of injury was accidental in 148 (36%) cases, self inflicted in 135 (33%) cases, assault in 105 (26%) cases, police intervention in 12 (3%) cases, and the cause was undetermined in 8 (2%) cases. Thirty-seven (25%) occurred while hunting. Most of these accidents occurred while deer hunting in November and December. Patients were primarily in their 2nd and 3rd decade of life.

CONCLUSION: Americans enjoy exercising their Second Amendment rights, and it is important to identify preventable firearm injuries. This study highlights trends in firearm injuries in one of the states with the highest rate of hunting-related injuries. The median age of hunting accidents in this timeframe was 33 years old, indicating that a possible public health intervention could include a requirement for a staged refresher course in an effort to reduce complacency and reinforce safe practices.

Extensor Digitorum Brevis Flaps for Lower Leg Soft Tissue Coverage

Abstract ID: Paper 238

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PURPOSE: The purpose of this study is to examine the use of extensor digitorum brevis (EBD) rotational flaps for distal soft tissue defects of the lower leg.

METHODS: Over a 5-year period, 14 patients underwent EDB flaps for malleoli, distal leg, or hindfoot soft tissue defects. Three of these patients underwent simultaneous soleus flap coverage for extensive defects around the middle third of the tibia. The mean age was 48 years (24-63), with 6 females, 7 patients with classified as ASA 3, with 3 smokers, 6 with diabetes mellitus and 4 obese patients. Eleven of the wounds were secondary to trauma, while the 3 patients requiring soleus flaps were secondary to necrotizing soft tissue infections. Mean time from initial wound onset to flap coverage was 57 days (5-215), with 12 patients having a wound present for >14 days. Leading up to surgery, 9 had a preoperative infection, with 6 having underlying osteomyelitis and 2 having necrotizing fasciitis. The mean number of irrigation and debridements (I&D) prior to the initial flap was 3 (0-7). The wounds were 7 medial, 3 anterior, 2 anteromedial, and 2 lateral. The mean size for the 11 isolated EDB flaps was 29 sqcm (15-45).

RESULTS: At a follow-up of 9 months (3-42), the overall EDB flap survival was 86%. One patient with a h/o severe peripheral vascular disease with a preoperative soft tissue infection requiring a soleus and EDB flap, whose postoperative course was complicated by a postoperative infection, requiring flap revision and eventual below knee amputation at 2 months postoperatively. There were no other postoperative infections or complications. Six patients underwent planned postoperative procedures involving skin grafting after initial Integra or allograft skin placement. The mean hospital stay after the initial flap was 7 days (4-15). At most recent follow-up, 13 (86%) of the limbs were salvaged, with all the wounds completely healed. All patients were able to fully weight bear at most recent follow-up. Reoperation rates and postoperative infections were increased by diabetes mellitus ($p<0.05$) and preoperative osteomyelitis ($p<0.05$), while flap survival was worse in smokers ($p=0.04$) and those requiring skin grafts >150 cm in size $p=0.04$).

CONCLUSIONS: Extensor digitorum brevis flaps are a reliable option for soft-tissue defect coverage of the malleoli, distal anterior leg, and hindfoot. This rotational flap can provide adequate coverage for small-medium wounds of the distal leg and ankle, where free flaps were traditionally used to cover.

Nerve Injury and Recovery After Traumatic Humeral Shaft Fracture in Adult Population

Abstract ID: Paper 239

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BACKGROUND: Nerve palsy is detected in up to 22% of humeral shaft fracture and radial nerve is the most commonly injured nerve. Isolated nerve injuries usually recover spontaneously and operative intervention is rarely indicated. Our goal was to study incidence of traumatic nerve injuries and recovery in a large cohort of patients with traumatic humeral shaft fractures.

METHODS: Records of 451 adult patients with humeral shaft fracture who presented to a level 1 trauma center from 2005 to 2014 were reviewed, and 91 patients who had documented traumatic nerve injury with at least 6 weeks follow-up were retrospectively enrolled into the study. The AO/OTA classification was used to classify fracture pattern by consensus among three trained examiners.

RESULTS: Nerve palsy was present in 91 (27.91%) patients at the time of injury. Radial nerve was the most commonly injured nerve (76.9%), followed by ulnar (5.5%) and axillary (3.3%) nerves. Thirteen patients (14.3%) had multiple nerves palsies. Nerve injury was significantly higher in middle and distal 1/3 fractures (45.5% and 41.8%, respectively) compared to proximal 1/3 (12.7%) (p=0.02). High energy injuries were associated with more nerve palsy (32.1% vs. 22.3%; p=0.045). There was lower risk of nerve injury with isolated humeral shaft fracture compared to patients with multiple traumas (22.3% vs. 33.1%; p=0.04). Patients who had concurrent vascular injury had higher risk of nerve injury (88.9% vs. 26.5%; p=0.001). Patients with open fracture had significantly higher rate of nerve palsy (45.8% vs. 22.8%; p=0.001). Nerve palsy was present in 47.3% of patients with simple (Type A), 21.8% of wedge (Type B), and 30.9% of complex (Type C) fracture patterns, but they were not statistically different (p=0.83). Patient who underwent operative treatment had higher prevalence of nerve injury compared to nonoperative group (38.3% vs. 13.8%; P=0.001). Spontaneous nerve recovery was detected in 71 (78.0%) patients with 42.3% partial and 58.7% complete recovery. Operative treatment of the fracture had no effect on the outcome of nerve recovery (79.2% vs. 73.7%; p=0.61). Presence of concurrent vascular injury predicted worse nerve recovery (37.5% vs. 81.9%; p=0.004).

CONCLUSION: The incidence of nerve injury after humeral shaft fracture was found to be 28% and high energy trauma patients with bilateral humeral fractures in the middle and distal third humeral shaft with concurrent vascular injury were at highest risk to have nerve injury. Operative treatment of humeral shaft fracture does not change the nerve recovery.

Nailing of Pertrochanteric Femur Fractures Using the Large Bone Distractor Without a Fracture Table

Abstract ID: Paper 240

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PURPOSE: A fracture or traction table is often used to obtain and maintain fracture reduction during nailing of pertrochanteric femur fractures. Some patients due to body habitus or ipsilateral foot/ankle pathology are challenging to position on the fracture table. The purpose of this study was to assess the results of using the large distractor (femoral distractor) to assist reduction during intramedullary nailing of pertrochanteric fractures on a radiolucent table.

METHODS: Patients were positioned supine on a radiolucent table with a small blanket roll under the injured side of the pelvis. A 6 mm Schanz pin was placed percutaneously under fluoroscopic guidance into the supra-acetabular bone in the region of the anterior-inferior iliac spine. A 5 mm Schanz pin was placed in the lateral 1/3 of the distal metadiaphyseal region of the femur. The large bone distractor was used to assist in obtaining and maintaining reduction during stabilization of the fracture with a long cephalomedullary nail. The distractor and Schanz pins were removed following nail placement with proximal and distal locking screws. The records of all patients treated with this technique by a single surgeon in a 1-year-period were reviewed.

RESULTS: Twenty-one pertrochanteric fractures were treated with the average age at the time of injury of 79 years. Surgery was performed on the day of admission in 8 patients, the next day in 10 patients, 2 days after admission in 2 patients, and 3 days after admission in 1 patient. The average total time in the operating room was 86 minutes. The average time from entering the OR until incision was 25 minutes, and the average time from incision until wound closure was 52 minutes. Four patients were deceased within 3 months of injury, and 1 patient was lost to follow-up prior to radiographic fracture healing. One patient developed a nonunion of the fracture with failure of fixation and was treated with conversion to total hip arthroplasty. The remaining 15 patients with radiographic follow-up until fracture union had an average final neck-shaft angle of 129° on the injured side compared to 135° on the uninjured side and an average tip-apex distance of 12 mm. There were no noted intraoperative or postoperative complications from the use of the distractor. All cases could be completed with this technique.

CONCLUSION: Pertrochanteric femur fractures treated with a long cephalomedullary nail can be reduced and stabilized on a radiolucent table with the assistance of the large bone distractor.

Functional Outcomes of Suprapatellar Approach vs. Traditional Approach for Intramedullary Fixation of Tibia Fractures

Abstract ID: Paper 241

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INTRODUCTION: Suprapatellar approach for intramedullary fixation (IMN) of tibia fractures has been described for difficult proximal one-third tibia fractures, and as an alternative to the traditional infrapatellar approach. Anterior knee pain remains a consistent known occurrence after traditional approach. Anterior knee pain traditionally has been assessed with the Lyschom Knee Score (LKS) in previous studies.

METHODS: This study was a retrospective review of all tibia fracture between 2010 and 2012 at a single institution with at least 18 months of follow-up. We compared infrapatellar approach to the suprapatellar approach and obtain (LKS) at final follow-up and compared the two groups. Visual analog score (VAS) was also obtained at final follow-up.

RESULTS: A total of 50 patients had undergone IMN during the time frame. Thirty-six met the inclusion criteria; 18 patients in the infrapatellar group and 18 in the suprapatellar group. A total of 19 patients were eligible for follow-up; 9 patients in infrapatellar and 10 suprapatellar. The average LKS for suprapatellar group was 83 and the infrapatellar group was 85.6. This was not significantly different. The visual analog score average was 2.05 for suprapatellar and 1.4 for infrapatellar. This was not significantly different. When evaluating specifics of the LKS, 8/10 patients in the suprapatellar group had a limp when walking compared to 5/9 of the infrapatellar group.

DISCUSSION: Overall, there was no difference in function using the Lyschom Knee Score, when comparing suprapatellar approach for intramedullary fixation of tibial fractures to infrapatellar or traditional approach in this study.

Low Dose CT Scanogram for Measurement of Femoral Version

Abstract ID: Paper 242

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INTRODUCTION: Low dose CT scanograms can reduce the ionizing radiation exposure to 10% of the current dose with no significant effect on the accuracy of the rotational measurement.

METHODS: CT scanogram protocols that used 90% and 10% of the usual dose of ionizing radiation were developed. Initial full body AP and lateral scout images were taken to confirm alignment of the lower extremities and for leg length measurement. Axial images were then taken at the femoral neck and condyles, using the scouts for alignment. Ten patients with comminuted femoral shaft fractures repaired with either an IM nail or plate were imaged with both high and low dose CT scanograms. The postoperative femoral version of both femurs were measured at both doses using the Bonesetter application. The CT scans were blinded and randomized for the study. Statistical analysis was performed including standard deviation and paired t-test. Significance was set at $p<0.05$.

RESULTS: There was no significant difference in the femoral version measurements between the 90% and 10% dose scanograms on either the native side or the repaired side ($p=0.870$ and $p=0.737$, respectively). On the native side, the mean error between observers was 2.1° in the 90% dose scan (range 0.8-4.4°) compared with a mean error of 1.7° in the 10% dose scan (range 0.5-3.3°). On the repaired side, the mean error in femoral version was 2.6° in the 90% dose scan (range 1.0-4.6°) vs. 1.6° in the 10% dose scan (range of 0.8-2.8°). No significant difference was found between the measurements of the difference in femoral version of the native and repaired femurs when comparing the 90% dose and 10% dose CT scanograms ($p=0.742$). The mean error between measurements was 2.7° for the high and 2.2° for low dose scans, with ranges of 0.6° to 5.5° and 0.8° to 4.9°, respectively.

CONCLUSION: Reducing the dose of ionizing radiation in a CT scanogram by 90% has no significant effect on the measurement of femoral version. This is a simple change that significantly reduces the radiation exposure to patients with femoral shaft fractures down to the level of a standard radiograph while still accurately measuring the femoral version and length.

HIP

Oral and Intravenous Tranexamic Acid Are Equivalent at Reducing Blood Loss Following Total Hip Arthroplasty

Abstract ID: Poster 001

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INTRODUCTION: Tranexamic acid (TXA) is an antifibrinolytic that has been shown to reduce blood loss and the need for transfusions when administered intravenously (IV) in total hip arthroplasty (THA). An oral formulation of the medication is available, at a fraction of the cost of the IV preparation. The purpose of this randomized controlled trial was to determine if oral administration is equivalent in terms of minimizing blood loss in primary THA.

METHODS: In this double-blinded, placebo-controlled trial, 64 patients undergoing primary THA were randomized to receive 1.95g TXA orally two hours preoperatively, or a 1g TXA IV bolus in the OR prior to incision. The primary outcome was reduction of hemoglobin. Power analysis determined 28 patients were required in each group with a ± 1.0g/dL hemoglobin equivalence margin between groups with an alpha of 0.05 and a power 80%. Equivalence analysis was performed with two-one sided t-tests (TOST) where a p-value of <0.05 indicates equivalence between treatments.

RESULTS: 28 Patients received IV TXA, 30 received oral, and 6 were excluded for protocol deviations. Patient demographics were similar between groups suggesting successful randomization. The mean reduction of hemoglobin between oral and IV groups were similar (3.82g/dL vs. 3.64g/dL; p=0.007, equivalence). Similarly, mean total blood loss was equivalent between oral and IV administration (1375ml vs. 1342ml; p=0.038, equivalence). Two patients in the oral group and one in the IV group were transfused, and none experienced a thromboembolic event.

CONCLUSION: Oral TXA provides equivalent reductions in blood loss in the setting of primary THA, at a cost of $14 compared to $47 to $108 depending on the IV formulation selected. With over 300,000 primary THA performed in the United States annually, a switch to oral TXA would yield total cost savings of $10 to $28 million per year for our health care system.

Tranexamic Acid in Total Hip Arthroplasty: Do Drug Formulation and Dosage Determine Efficacy and Safety?

Abstract ID: Poster 002

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INTRODUCTION: Tranexamic acid (TXA) is a synthetic antifibrinolytic agent successfully used to reduce blood loss and transfusion rates following total hip arthroplasty (THA). The growing body of randomized controlled trials (RCT) has demonstrated the efficacy of intravenous (IV), topical, and oral TXA compared to placebo, but there is scarce data comparing various formulations of the drug. The purpose of this network meta-analysis (NMA) was to provide a quantitative synthesis of the entire body of RCTs on TXA in THA.

METHODS: We searched the Medline, Cochrane, and EMBASE databases for all RCT performed before April 2015 on TXA in THA. Studies enrolling patients with primary THA were eligible. Patients were stratified into low dose IV (LDIV, ≤ 20 mg/kg), high dose IV (HDIV, >20 mg/kg), topical, and oral TXA groups. We then applied Bayesian NMA, which combines both direct and indirect evidence from all RCT to allow pairwise comparisons of all treatment groups. Dichotomous outcomes were compared using odds ratios (OR) and continuous outcomes were compared using mean differences (MD). Treatment rankings were calculated using the surface under the cumulative ranking algorithm.

RESULTS: 19 RCT, including 1,388 patients, were eligible. Topical and IV TXA formulations were statistically superior to placebo in terms of blood loss and risk of transfusion. HDIV TXA offered significantly lower blood loss than LDIV and oral TXA while all other comparisons demonstrated no difference. No difference was observed between TXA formulations with regards to risk of transfusion. No significant difference was noted between any treatment and placebo in terms of risk for deep venous thrombosis (DVT) or pulmonary embolism (PE).

DISCUSSION: TXA formulation and dosage have a direct effect on measured blood loss with HDIV TXA providing superior results compared to LDIV and oral TXA. However, these differences did not translate into lower rates of transfusion, with all IV and topical TXA formulations being better than placebo but equivalent to each other in this more clinically relevant outcome. No TXA formulation portended a higher risk of symptomatic DVT or PE. We believe the observed lack of superiority between HDIV and oral TXA is an artifact of inadequate dosing that does not allow for the patient to achieve a therapeutic serum level. Thus, all IV and topical TXA formulations are equivalent in terms of efficacy and safety, suggesting use of the lowest cost formulation to provide significant savings to the healthcare system.

Metal Ion Induced Cardiomyopathy in Dual-Taper Modular Total Hip Arthroplasty

Abstract ID: Poster 003

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INTRODUCTION: The use of metal-on-metal (MOM) and modular total hip arthroplasty (THA) is associated with elevated serum metal ion levels, which may result in systemic symptoms. The primary aim of this analysis was to identify associations between serum metal ion levels and echocardiogram findings in a population of patients with dual-taper modular THA.

METHODS: We evaluated prospectively collected data from 47 patients, mean age 58.7 years, who underwent implantation of dual-modular THA from 01/2004 - 01/2010. The collected data spanned a 5-11 year period from the time of index procedure. Serum metal ion levels, including titanium, cobalt, and chromium (ng/mL), were collected in 2012 and 2015. Echocardiograms were performed on each patient by a trained technologist and evaluated by a certified cardiologist. We evaluated cardiac ejection fraction, left ventricle (LV) size, LV wall thickness, LV diastolic filling defect (grade), right ventricle (RV) size, and pulmonary artery (PA) pressure.

RESULTS: There was no correlation between serum metal ion levels or ratios and ejection fraction, right ventricle size, and pulmonary artery pressure. The serum cobalt to chromium (CO:CR) ratio measured in 2015 was significantly higher in patients with mildly increased LV size compared to those with normal LV size (p=0.028). There was an inverse correlation between serum cobalt in both 2012 and 2015 relative to normal, mild, and moderately increased LV wall thickness (2012: p=0.044; 2015: p=0.005). A similar correlation was found between serum chromium and normal, mild, and moderately increased LV wall thickness in both 2012 and 2015 (2012: p=0.025; 2015: p=0.027). There was an inverse relationship between serum cobalt in 2012 and 2015 relative to LV diastolic filling defect grade (2012: p=0.009; 2015: p=0.028). There was also an inverse relationship between serum chromium in 2015 and LV diastolic filling defect grade (p=0.036).

DISCUSSION/CONCLUSION: Serum CO:CR ratios at long-term follow-up were correlated with increased LV size. Increasing LV wall thickness was inversely correlated with cobalt and chromium levels at both mid- and long-term follow-up. Increased grade of LV diastolic filling defect was correlated with decreasing serum cobalt at mid- and long-term follow-up and decreasing serum chromium at long-term follow-up.

Cobalt Chromium Ratios in Dual-Taper Modular Total Hip Arthroplasty

Abstract ID: Poster 004

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INTRODUCTION: The use of metal-on-metal (MOM) and modular total hip arthroplasty (THA) is associated with a number of ill effects including elevated serum metal ion levels, pseudotumor, cardiomyopathy, neurologic abnormalities, and increased rates of implant loosening and need for revision. The primary aim of this analysis was to identify correlations between the serum ratio of cobalt to chromium and the presence of implant loosening or need for revision in dual-modular THA.

METHODS: We evaluated prospectively collected data from 117 patients who underwent implantation of dual-modular THA from 05/2003 - 03/2010. The collected data spanned a 2-9 year period from the time of index procedure. Serum metal ion levels, including titanium, cobalt and chromium, were collected in 2012. The ratio of serum cobalt to chromium (CO:CR) was calculated. A chart review was conducted to determine the incidence of implant loosening and revision.

RESULTS: Amongst the 117 patients, there were 58 metal on metal (MoM) implants, 36 metal on polyethylene (MoP), and 23 ceramic. A total of 6 (5.1%) patients had implant loosening and 5 (4.3%) patients required revision. There was no loosening observed in the MoM group, 5 in the MoP group, and 1 instance of loosening in the ceramic group. Amongst revised patients, 2 had MoP, 1 MoM, and 2 ceramic bearing surfaces. The average CO:CR ratio in patients with loose implants was 2.32 ± 2.39 and 1.78 ± 1.59 in patients with stable implants (p=0.438). In patients requiring revision, the serum CO:CR ratio was 1.79 ± 0.73 and 1.81 ± 1.66 in non-revised patients (p=0.974). Within each bearing surface subgroup, there was no statistically significant variation in CO:CR for either implant loosening or revision.

CONCLUSION: This study found no difference in serum CO:CR ratios in patients with clinical evidence of implant loosening or those who underwent revision procedures. Furthermore, subgroup analysis by bearing surface type did not show a significant difference in serum CO:CR ratios relative to loosening or revision.

Incidence, Risk Factors, and Sources of Sepsis Following Total Joint Arthroplasty

Abstract ID: Poster 005

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INTRODUCTION: Sepsis is a rare but serious complication following total joint arthroplasty (TJA). Common sources include urinary tract infection (UTI), surgical site infection (SSI), and pneumonia. The purpose of this study is to characterize the incidence, risk factors, and sources of sepsis following TJA.

METHODS: Patients undergoing primary total hip arthroplasty (THA) or total knee arthroplasty (TKA) during 2005-2013 were identified in the American College of Surgeons National Surgical Quality Improvement Program database. Among patients who developed sepsis, the proportions of patients who concurrently were diagnosed with UTI, SSI, or pneumonia were characterized. Independent associations were tested for using multivariate regression adjusting for all demographic, comorbidity, and procedural characteristics.

RESULTS: 117,935 patients were identified (45,612 undergoing THA and 72,323 undergoing TKA). Of these, 402 (0.34%) developed sepsis following surgery. Patients who developed sepsis had an elevated mortality rate (3.7% vs. 0.1%, $p<0.001$). Among the 402 patients who developed sepsis, 124 (31%) had concomitant UTI, 110 (27%) SSI, and 60 (15%) pneumonia. 21 patients (5%) had multiple infectious sources and 129 patients (32%) had no identifiable source. The rate of sepsis was increased in patients who developed UTI (9.2% vs. 0.2%, $p<0.001$), SSI (14.7% vs. 0.3%, $p<0.001$), and pneumonia (9.5% vs. 0.3%, $p<0.001$). Independent risk factors for sepsis included greater age, male sex, functional dependence, insulin-dependent diabetes, hypertension, chronic obstructive pulmonary disease, current smoker, and greater operative time ($p<0.05$ for each).

CONCLUSION: These findings suggest that the rate of sepsis following total joint arthroplasty is about 1 in 300, and that sepsis is associated with a high risk of mortality. The most common sources of sepsis are UTI, SSI, and pneumonia accounting for approximately 2/3 of cases. Given the seriousness of this complication, UTI, SSI, and pneumonia should be treated aggressively to minimize the risk of mortality.

A Multi-Center Randomized Clinical Trial of Articulating and Static Spacers for Periprosthetic Hip Infection

Abstract ID: Poster 006

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INTRODUCTION: Although the use of an interim antibiotic spacer is considered standard for a two-stage exchange for periprosthetic joint infection (PJI), the use of an articulating vs. a static spacer is controversial. The purpose of this multicenter, randomized trial is to compare articulating and static spacers for the treatment of PJI after total hip arthroplasty (THA).

METHODS: 36 patients who met MSIS criteria for PJI following a primary THA at 3 centers were randomized; 17 into the articulating and 19 in the static group. Power analysis determined that 44 total patients were needed to identify a difference in operative time during the second stage (β=0.80 and α=0.05). Demographics between the two groups were not significantly different, suggesting appropriate randomization. Statistical analysis was performed using t-tests for normally distributed variables and Wilcoxon tests for non-normally distributed variables.

RESULTS: For the stage 1 procedure, there were no differences in operative time (201 articulating vs. 195 minutes static, p=0.702), blood loss (762 vs. 579 ml, p=0.163), units of blood transfused (0.35 vs. 0.74, p=0.176), or likelihood of discharge to home with the number of patients available for study. Similarly, at reimplantation there were no differences in operative time (194 articulating vs. 187 minutes static, p=0.840), blood loss (642 vs. 469 ml, p=0.235), units of blood transfused (0.64 vs. 1.06, p=0.309), or discharge disposition. Length of stay was significantly longer in the static group following stage 1 (5.2 vs. 8.7 days, p=0.011) and stage 2 (3.9 vs. 6 days, p=0.009). Three patients in the static group and 2 in the articulating group required a second debridement and spacer prior to reimplantation.

CONCLUSIONS: Initial results of this multicenter randomized trial demonstrate few differences between the two techniques. Length of stay, however, was longer in the static group, which could have important economic consequences for the hospital.

Pain Management and Its Relationship With Patient Satisfaction in Total Joint Replacement Surgery

Abstract ID: Poster 007

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INTRODUCTION: Pain management is instrumental in delivering high quality care and patient satisfaction in joint replacement surgery. Since the federal government began mandating healthcare organizations to report on patient satisfaction through The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey in 2007, Medicare and Medicaid reimbursements have been directly influenced by its results. The Centers for Medicare and Medicaid Services (CMS) give credit only when patients award hospitals a >9 out of 10 or a “Always” response. As a result, hospital organizations have sought to improve patient satisfaction, focusing much of their attention to pain management. Yet despite the surveys profound impact on reimbursements, the relationship between pain management and patient satisfaction has been unclear. This study aims to evaluate the relationship between patient perception of pain control and their overall satisfaction after joint replacement surgery.

METHODS: This study is a retrospective review of all primary total hip and total knee arthroplasties performed by 4 fellowship-trained, joint reconstruction surgeons from October 2013 to January 2015. A total of 286 patients who underwent primary total hip (N=106) and total knee (n=196) replacements with completed HCAHPS surveys were evaluated. Responses to questions regarding pain control (Question 13), communication (Questions 14, 16, 17), and hospital satisfaction (Questions 21, 22) were dichotomized, grouping patients as either 9-10/Always or a lesser response. These two groups were compared in terms of visual analog score (VAS), opioid use in morphine equivalents, length of stay, surgical time, anesthesia type, and demographics. Pain management protocols were standardized.

RESULTS: Average VAS, opioid totals, surgical time, and anesthesia type did not differ between patient groups for any of the 6 questions. Those who responded Always to questions 13, 16, or 17 had a statistically shorter length of stay compared to those who responded with any other response. On average, those who endorsed Always' on questions 16 or 17 were younger. No other demographics differed.

DISCUSSION: Patient satisfaction scores reported in the HCAHPS survey have directly influenced CMS reimbursements. This retrospective review further characterizes the relationship between patient satisfaction scores and the perception of pain control in patients who received total joint arthroplasty. The data reveals that patient perception of good pain control (Question 13) and staff communication of pain management (Questions 16, 17) are related to shorter length of stay. Interestingly, there was no relationship between survey scores and traditional pain control measures such as VAS and opioid use. This questions the clinical relevance of traditional pain measures in the joint replacement patient. Length of stay may be a better surrogate marker for patient satisfaction of pain control and supports further investigation into more holistic pain outcome measures.

Mid-Term Results of Total Hip and Total Knee Arthroplasty in Patients With HIV

Abstract ID: Poster 008

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INTRODUCTION: Since the introduction of anti-retrovirals, HIV patients are living longer and increasingly becoming candidates for total hip arthroplasty (THA) and total knee arthroplasty (TKA). Prior reports outlined the early postoperative risks of THA and TKA in these patients, but the mid- and longer-term outcomes remain unclear. We specifically sought to determine: (1) the early risk of complications, (2) specific subgroups at risk for complications, and (3) the mid-term reliability and durability of THA and TKA in HIV patients in a larger series with extended follow-up.

METHODS: We retrospectively reviewed 21 HIV patients who underwent 29 primary arthroplasties from 1992 to 2012 (14 THAs and 15 TKAs). Mean age was 43 years, with a mean follow-up of 8 years. Clinical outcomes, survivorship, and complications were analyzed.

RESULTS: The risk of perioperative complications was high at 17%. The specific subgroup of patients with both hemophilia and HIV was at particular risk for perioperative complications at 33% ($p = 0.04$). At mid-term follow-up, THAs and TKAs were reliable in alleviating pain and improving function (mean Harris hip score = 85, $p< 0.01$; mean Knee Society score = 83, $p< 0.01$). The durability of THAs and TKAs at mid-term follow-up was lower than expected with 5- and 10-year survival free of any revision or reoperation calculated as 84% and 71%, respectively. At most recent follow-up, 3 hips (21%) and 1 knee (7%) were revised. There were 2 additional reoperations (7%).

CONCLUSIONS: In patients with HIV, both THA and TKA are reliable in alleviating pain and improving clinical function at mid-term follow-up. However, HIV patients are at substantial risk of perioperative complications and had substantially poorer survivorship free of revision or reoperation as compared to patients with a diagnosis of osteoarthritis. Those patients with both HIV and hemophilia are at particular risk for perioperative complications.

SUMMARY: In addition to a substantial risk of perioperative complications, patients with HIV who undergo THA or TKA also have a substantial risk of revision or reoperation at 5 and 10 years.

Keywords: HIV; Total Hip Arthroplasty (THA); Total Knee Arthroplasty (TKA); Complications

Prospective Evaluation of Bone Density Following Hip Arthroplasty Surgery in a Cohort of Young, Active Patients

Abstract ID: Poster 009

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BACKGROUND: Total hip (THA) and surface replacement arthroplasty (SRA) are commonly performed in young, active patients who desire a return to high impact activities. The purpose of this study was to evaluate femoral bone density over a five-year period following THA with modern cementless femoral stems and SRA in young, active patients.

METHODS: 96 patients undergoing THA (45 hips) with tapered, proximally coated stems or SRA (58 hips) were prospectively enrolled. Inclusion criteria were age <65 years, BMI <35 kg/m^2, and a pre-symptomatic UCLA score > 6. Bone mineral density (BMD) of the 7 femoral Gruen zones was measured using DEXA scans at 6 weeks, 6 months, 1, 2, and 5 years postoperatively. Six-week BMD values were used as the baseline to calculate the percent change in BMD at 6 months, 1, 2, and 5 years for each patient. Student's t-tests and Pearson's chi square tests were performed ($p<0.05$=significant).

RESULTS: No differences were present in the preoperative or postoperative UCLA or Harris Hip scores between SRA and THA cohorts (p=0.07- 0.67). In the SRA cohort, femoral neck bone density increased most at the proximal lateral femoral neck ($p < 0.0001$). Bone density was increased in the SRA vs. THA cohort at all postoperative intervals for Gruen zones 1, 2, 6, and 7 ($p<0.03$). In the SRA cohort, the mean bone density ratio ranged from 98.7% (Gruen zone 2) to 106.1% (Gruen zone 7 – medial calcar) at 5 years postoperatively. In the THA cohort, bone density never returned to baseline in Gruen zones 1, 2, 6, and 7 (91.2%, 94.8%, 97.3%, and 89.2%), with the greatest decrease in Gruen zone 7.

CONCLUSION: Despite the use of cementless, proximally-coated femoral stems, femoral bone density decreased over time in young, active patients undergoing THA, while SRA patients demonstrated an increased bone density at all intervals.

Assessing Risk Factors for 30-Day Readmission After Total Hip Arthroplasty: A Retrospective Analysis

Abstract ID: Poster 010

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INTRODUCTION: The Affordable Care Act (ACA) outlines provisions that change healthcare reimbursements based on quality measures. Under new regulations, clinicians and hospital institutions are assessed by various parameters, such as rates of readmissions. As a result, it is necessary that clinicians understand contributory factors associated with increased hospital readmission rates. Identifying such risk factors will assist in efforts to reduce the financial burden on the healthcare system, while also improving patient outcomes. The goal of this study is to identify potential risk factors that may contribute to readmission within 30 days following a total hip arthroplasty (THA).

METHODS: Data collected revealed 1,251 patients who underwent THA at a level 1 trauma center from January 2010 to December 2013. Patient data was categorized into two groups based on postoperative 30-day readmission status. Group I consisted of 1,190 patients who were not readmitted following surgery. Group II consisted of 61 patients with ≥1 readmission. Potential risk factors assessed were demographics, social factors, medical comorbidity, surgical indications, and postoperative interventions. Logistic regression using the Firth penalized likelihood was used to determine which variables best predict readmission. Statistical significance was considered with a p-value <0.05.

RESULTS: Following analysis of the data, several risk factors for 30-day readmission following THA were identified. The risk of readmission increased significantly with longer length of stay (LOS) and was represented with an odds ratio of 1.268 (95% CI). Comorbid pulmonary disease was shown to increase risk of readmission with an odds ratio of 2.3048 (95% CI) and chronic kidney disease (CKD) with an odds ratio of 3.287 (95% CI). Variables such as smoking tobacco, urinary tract infection, acute kidney injury, anemia, payer type, and endocrine/metabolic/circulatory dysfunction did not significantly affect risk of readmission.

CONCLUSION: Patients were found to exhibit a significantly increased risk of 30-day readmission following THA when diagnosed preoperatively with pulmonary disease and chronic renal failure. Longer length of the primary hospital admission was also found to be a significant risk factor for readmission within 30 days following discharge. Further research is needed to determine how our results can be utilized to reduce 30-day readmission rates after THA.

Are Readmissions Following Total Hip Arthroplasty Preventable?

Abstract ID: Poster 011

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INTRODUCTION: Readmissions following total joint arthroplasty contribute to cost of the episode of care, and have been targeted as a quality metric in pay-for-performance compensation models. Considerable effort has been devoted to identifying important patient risk factors for these events. For these reasons, we investigated whether readmissions were related to operative or non-operative factors. Furthermore, we sought to identify which readmissions might have been potentially preventable during the initial hospitalization.

METHODS: We utilized the quality database of a major academic healthcare system to identify patients who underwent elective total hip arthroplasty from January 1, 2011, through June 30 2014. Patients that were readmitted within our healthcare system within 30 and 90 days of the index procedure were identified and analysis of their readmission performed. Readmissions were categorized into operative and non-operative groups. Patient charts were reviewed. Cases were classified as being potentially preventable or non-preventable based on objective criteria from peer-reviewed consensus guidelines published in respective specialty journals whenever possible.

RESULTS: Of 1096 THA patients discharged during the study period, 50 patients (4.6%) were readmitted within 30 days, and 69 (6.4%) within 90 days of their index procedure. There were 31 operative (44.9%) and 38 non-operative (55.1%) readmissions. Readmissions occurring in the first 30 days were more likely to be operative than those occurring after 30 days (52.0% in first 30 days vs. 21.1% during days 31-90, p= 0.029). Three patients (5.8%) were considered readmissions that were potentially preventable. Of these potentially preventable readmissions, one was operative (hip dislocation), and two were non-operative. These readmissions occurred at 5, 9, and 24 days after the index procedures.

DISCUSSION: At our institution, readmissions occurred for operative and non-operative reasons. Only a small percentage of readmissions to our health care system were considered potentially preventable. In the vast majority of cases, readmissions were determined to be unpreventable based on the patient's condition during the initial hospitalization. Readmissions following elective total hip arthroplasty are difficult to predict and prevent and may not be a valid target in pay for performance compensation models. Most readmissions after elective total hip arthroplasty reflect appropriate care in perioperative period. Readmission statistics may not be a valid means for determining quality of care.

Preoperative Evaluation for Pelvic Discontinuity Utilizing a New Reformatted CT Scan Protocol

Abstract ID: Poster 012

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INTRODUCTION: The identification of suspected pelvic discontinuity is important for preoperative planning in revision hip arthroplasty. Computed tomography of the pelvis with reconstructions in the axial, sagittal, and coronal planes has been previously described for the identification of pelvic discontinuity, but fails to show some discontinuities. The purpose of this study was to determine if reformatted 45° oblique CT scans of the pelvis -- similar in projection to Judet views on plain films -- provide advantages in detecting pelvic discontinuity preoperatively over standard reconstruction CT scans.

METHODS: We describe a new technique of reformatting conventional CT scans to present 45° oblique views of the pelvis. Using an institutional joint registry, we retrospectively identified 22 patients who had intraoperative findings of pelvic discontinuity and also had a preoperative CT scan of the pelvis. These included standard reconstructions in the axial, sagittal, coronal, as well as reconstructions at 45° obliques in the coronal planes to form an iliac oblique and obturator oblique CT view. All CT scans were reviewed by the senior author, as well as a musculoskeletal radiologist. The criterion for diagnosis of pelvic discontinuity was a continuous visible fracture line involving the entire width of the anterior and posterior columns.

RESULTS: Utilizing the standard axial, sagittal, coronal reconstructions, pelvic discontinuity was identified in 16 of the 22 patients. After reformatting these CT scans using the 45° oblique reconstructions, we were able to identify the discontinuity in 20 of the 22 patients. In the remaining 2, a fracture line could be seen, but it was not continuous. Standard reconstruction CT scans were 73% sensitive in identifying discontinuity based on these parameters and the addition of reformatted 45° oblique CT scans increased sensitivity to 91%.

DISCUSSION: CT scans of the pelvis with reconstructions at 45° iliac oblique and obturator oblique views in patients with suspected pelvic discontinuity provide a high level of sensitivity when the diagnosis cannot be firmly established from plain films. The new CT reconstruction formats described in this paper may also have utility in acetabular fracture evaluation.

Complications and Risk Factors for Morbidity in Elective Hip Arthroscopy: A Review of 1,325 Patients

Abstract ID: Poster 013

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INTRODUCTION: Arthroscopic treatment of the hip is a well-described method for treating a number of pathologies. Overall complications have been reported in 1-20% of patients undergoing hip arthroscopy. We recognize a lack of previous literature that considers risk factors for patient morbidity in conjunction with large multi-institutional cohorts in the setting of hip arthroscopy. The purpose of this study was to define in patients undergoing elective hip arthroscopy (1) the type and incidence of complications, and (2) risk factors for morbidity.

METHODS: We queried the National Surgical Quality Improvement Program database and identified patients who underwent elective hip arthroscopy between 2006 and 2013. Postoperative outcomes were categorized as: any 30-day complication, major morbidity or mortality (systemic life-threatening event or a substantial threat to a vital organ), and minor morbidity (localized to the operative lower extremity or not posing a major systemic threat to the patient). We performed univariate and subsequent multivariate analyses to identify risk factors for complications.

RESULTS: Among 1,325 patients who underwent elective hip arthroscopy, at least one complication was experienced by 1.21% (16 patients) of patients. There were 6 major complications (0.47%) and 12 minor complications (0.91%). Bleeding resulting in transfusion was the most common complication (6 patients, 0.45%) followed by return to the operating room (3 patients, 0.23%) and superficial surgical site infection (3 patients, 0.23%). There were no incidences of patient mortality. Univariate analysis identified age, CPT code, hypertension, and steroid use as risk factors for any complication. For the outcome of major morbidity, univariate analysis found no risk factors for complication. For the outcome of minor morbidity, univariate analysis identified age, hypertension, steroid use, and CPT code as risk factors for complication. The multivariate analysis found age greater than 65 years as an independent predictor of any complication (odds ratio [OR], 6.52; 95% confidence interval [CI], 1.35-31.54) and minor morbidity (OR, 7.97; 95% CI, 1.21-52.72). Surgical time was less than 3 hours in 91% of patients and less than 2 hours in 70% of patients.

DISCUSSION AND CONCLUSION: We found short-term morbidity after elective hip arthroscopy is low. Surgeons performing hip arthroscopy should be aware that age greater than 65 years is an independent risk factor for complication and careful consideration of risks and benefits of hip arthroscopy should be given to this group. These results may aid surgeons in counseling patients, and may aid health systems in performing quality assessment.

Simultaneous Bilateral vs. Staged Bilateral Total Hip Arthroplasty: A Matched Survival Study

Abstract ID: Poster 014

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INTRODUCTION: There continues to be debate regarding the role of simultaneous vs. staged bilateral total hip arthroplasty (THA) for patients with end-stage bilateral osteoarthritis. Previous studies have shown that simultaneous bilateral THA is associated with higher short-term complications, but there is limited data comparing implant survival.

METHODS: Using our institution's total joint registry, we identified 124 consecutive patients (248 hips) who underwent simultaneous bilateral THA. Patients had a mean age of 52 years, mean BMI of 27.5 kg/m^2, and 43% were female. These patients were matched 1:1 based on gender, age, and year of surgery (± 3 years) to a cohort of patients undergoing a staged bilateral THA. In the staged group, there was less than one year between procedures. Mean follow-up was 5 years for each group. Kaplan-Meier implant survival outcomes were assessed in addition to postoperative complications and short-term mortality (30- and 90-day) between groups.

RESULTS: There was no difference (HR 0.76, P=0.51) in the overall 5-, 10-, 15-, 20-year revision free survival in patients undergoing a simultaneous or staged bilateral THA (95% vs. 91%), (84% vs. 85%), (84% vs. 82%), and (84% vs. 73%), respectively. The risk of reoperation (HR 0.79, P=0.54), postoperative infection (HR 0.98, P=0.98), and postoperative complications (HR 0.97, P=0.89) was also similar between groups. There were no differences in 30-day (0% vs. 0.8%, p=1.0), 90-day (0.8% vs. 0.8%, p=1.0) or overall (HR 0.81, P=0.41) mortality between groups. Likewise, there was a similar rate of periprosthetic fracture (3.2% vs. 4.4%, P=0.80), dislocation (2.4% vs. 1.6%, p=0.74), DVT (1.6% vs. 0.8%, P=0.68), and wound complication (0.8% vs. 1.6%, p=0.68).

CONCLUSION: Previous studies have shown increased rates of perioperative complications following simultaneous bilateral total hip arthroplasty. In this matched cohort analysis, simultaneous bilateral THA was not associated with an increased risk of revision, reoperation, infection, or postoperative complications compared to a group of patients with staged procedures. In our experience, simultaneous bilateral THA is a safe procedure with similar survival and complication risk compared to staged bilateral THA and, for select patients, offers an excellent means to deal with concomitant bilateral coxarthrosis.

KNEE

Hypoalbuminemia Predicts Joint Infection, Pneumonia, and Readmission After Total Joint Arthroplasty

Abstract ID: Poster 015

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INTRODUCTION: Malnutrition is a potentially modifiable risk factor for complications following total joint arthroplasty (TJA). While prior studies have identified associations between malnutrition, delayed wound healing, and surgical site infection (SSI), few studies have investigated the relationship between malnutrition and other complications. The purpose of this study is to investigate the association between preoperative hypoalbuminemia, a marker for malnutrition, and complications during the 30 days following TJA.

METHODS: Patients who underwent elective primary total hip and knee arthroplasty during 2011-2013 as part of the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) were identified. Only patients with preoperative serum albumin concentration were included. Outcomes were compared between patients with and without hypoalbuminemia (serum albumin concentration<3.5g/dL). All associations were adjusted for demographic, comorbidity, and laboratory differences between populations.

RESULTS: 49,603 patients were included. The prevalence of hypoalbuminemia was 4.0%. In comparison to patients with normal albumin concentration, patients with hypoalbuminemia had a higher risk for SSI (2.29% vs. 0.96%, adjusted relative risk [RR]=2.0, $p<0.001$) and pneumonia (1.27% vs. 0.30%, adjusted RR=2.5, $p<0.001$). Similarly, patients with hypoalbuminemia had a higher risk for occurrence of any complication (7.3% vs. 4.0%; adjusted RR=1.5, $p<0.001$) and occurrence of a serious complication (2.1% vs. 1.2%; adjusted RR=1.4, $p=0.042$). The rate of hospital readmission was higher for patients with hypoalbuminemia (6.3% vs. 3.5%; adjusted RR=1.4, $p<0.001$).

CONCLUSION: The present study provides evidence that malnutrition is an independent risk factor for SSI, pneumonia, occurrence of any complications, and occurrence of serious complications following TJA. This study also demonstrates that malnutrition is independently associated with increased readmission. Future efforts should investigate methods of correcting nutritional deficiencies prior to TJA. If successful, such efforts could lead to substantial improvements in short-term outcomes for patients.

Do Injections Increase the Risk of Infection Following TKA?

Abstract ID: Poster 016

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INTRODUCTION: The purpose of this study was to identify if postoperative infection rates after TKA are increased following preoperative knee injection and if duration of time between injection and the TKA procedure plays a role in rates of postoperative infection.

METHODS: The Humana Inc. dataset was reviewed from 2007-2014 for all patients who received a knee injection prior to their ipsilateral TKA within one year. The cohort was then stratified by monthly time intervals out to 12 months postoperatively corresponding to duration between injection and TKA. Postoperative infection within 90 days of primary TKA was identified using ICD-9/CPT codes. Records without laterality designation were excluded and analysis was performed using standard statistical techniques.

RESULTS: In total, 83,684 patients underwent TKA; 29,603 patients (35.4%) had an injection in the ipsilateral knee at least one year prior to TKA; and 54,081 patients (64.6%) did not. There were no significant differences in Charlson Comorbidity Index between these cohorts. Rates of any surgical site infection were significantly higher in patients with an injection prior to TKA than those without (4.4% vs. 3.6%), as were rates of infection requiring return to the operating room (1.5% vs. 1.0%; $p<0.05$ for both). Odds ratio with 95% confidence intervals (OR) for these endpoints were 1.2 (1.15-1.3, $p < 0.0001$) and 1.4 (1.3-1.6, $p<0.0001$), respectively.

Additionally, rates of infection requiring return to operating room remained significantly higher for the injection cohort out to a duration of seven months between injection and TKA. Odds ratio for increased infection in the injected TKA group were 1.8 at 1 month, 1.6 at 2 months, and 1.3 at 3 months duration between procedures. There were no significant differences in infection when longer than 7 months passed between injection and TKA.

CONCLUSIONS: There was a significantly higher OR of any postoperative infection (OR 1.2) and infection requiring return to operative room (OR 1.4) when patients received an injection prior to TKA. This finding remaining significant out to a duration of 7 months between injection and TKA. This association between injection and infection after TKA is important to consider during an arthroplasty surgeon’s management of patients who have undergone recent knee injection.

Insulin Dependence Increases the Risk of Failure in Morbidly Obese TKA

Abstract ID: Poster 017

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BACKGROUND: Morbid obesity is associated with an increased risk of complication following primary total knee arthroplasty (TKA), but it is widely acknowledged that body mass index (BMI) is a nonspecific value. It is possible that the presence of diabetes mellitus could help further stratify risk within this population.

QUESTIONS/PURPOSES: The aims of this study were to compare the survival and risk factors for reoperation, revision, and periprosthetic joint infection (PJI) between non-diabetic, diabetic, and insulin-dependent morbidly obese (BMI ≥40 kg/m^2) patients undergoing primary TKA.

METHODS: We identified all morbidly obese patients who underwent primary TKA at a single institution over a 17-year period (1995-2011) with minimum follow-up of two years (n=1,850 knees). Patients with type II diabetes mellitus (DM) were identified (n=530 knees, mean follow-up 6 years), and compared to non-diabetic patients (n=1,284 knees, mean follow-up 6 years). Of the 530 patients with type II DM, 164 (31%) patients were insulin-dependent. Patients with type I diabetes mellitus were excluded (n=36 knees) from the analysis. Medical records were reviewed for details regarding outcomes.

RESULTS: Overall, diabetic patients had similar risk of reoperation (HR 1.2, p=0.17), revision (HR 1.3, p=0.28), and PJI (HR 0.8, p=0.34) when compared with non-diabetic morbidly obese patients. However, insulin dependence did increase the risk of reoperation (HR 1.8, p=0.005), revision (HR 2.0, p=0.02), and PJI (HR 2.1, p=0.03). Age ≤ 65 years decreased the risk of revision (HR 1.6, p=0.03), but did not affect reoperation or infection. Gender was not a significant risk factor. Implant survival rates were similar between non-diabetic and diabetic patients, with respective survival of 96% (95-97%) vs. 95% (93-97%) at five years and 92% (90-94%) vs. 89% (84-94%), (p=0.27).

CONCLUSION: In our experience of more than 1,800 morbidly obese patients undergoing primary TKA, diabetes mellitus did not affect the risk of reoperation, revision, or PJI. However, those with insulin dependence do seem to be at increased risk of these outcomes. Future studies should aim to better evaluate glycemic control within this patient population.

Repair of Intraoperative Injury to the Medial Collateral Ligament During Primary Total Knee Arthroplasty

Abstract ID: Poster 018

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INTRODUCTION: Optimal treatment for intraoperative injury to the medial collateral ligament (MCL) during primary total knee arthroplasty (TKA) remains controversial. While some advocate primary ligament repair and a period of bracing, others suggest conversion to a knee with increased intrinsic constraint. The purpose of this study is to characterize the outcomes of primary repair followed by bracing.

METHODS: We performed a retrospective review of consecutive primary TKAs to identify patients with intraoperative MCL lacerations or avulsions treated with primary repair. For mid-substance lacerations, end-to-end suture repair was performed; for avulsions, a screw/washer construct or suture anchors were used for reattachment. All patients were instructed to wear an unlocked hinged knee brace for six weeks postoperatively. Patients were evaluated at a minimum of two years postoperatively for evidence of instability or other modes of failure and complications.

RESULTS: Of the 3,922 TKAs performed, 48 (1.2%) had an intraoperative MCL injury. One patient died prior to 2 postoperative years, one was lost to follow-up, and one was converted intraoperatively to a constrained TKA, leaving 45 TKAs available for study. Of these, 24 were mid-substance lacerations and 21 were avulsions; 35 were associated with a cruciate-retaining TKA and 10 with a posterior-stabilized TKA. At a mean follow-up of 99 months (range, 24-214 months), there were no subjective complaints or physical examination findings of instability. The mean Hospital for Special Surgery knee score had increased from 47 to 85 ($p<0.001$). Five TKAs required intervention for stiffness (4 manipulations and 1 revision) and two required revision for aseptic loosening. In the three knees undergoing re-operation, the MCL was noted to be in continuity.

CONCLUSIONS: Our results suggest that intraoperative MCL injury can be treated by primary repair followed by hinged knee bracing without the need for increased prosthetic constraint. Stiffness, however, was a common complication.

Arthrofibrosis After Contemporary Total Knee Arthroplasty

Abstract ID: Poster 019

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INTRODUCTION: Despite advancements in surgical technique, implant design, and pain management, arthrofibrosis remains one of the top 5 reasons for revision total knee arthroplasty (TKA). The aim of this study was to investigate the incidence of arthrofibrosis after TKA, study trends over the past 20 years, and delineate how frequently the problem persisted after manipulation under anesthesia (MUA).

PATIENTS AND METHODS: 9,798 patients who underwent primary cemented posterior-stabilized TKA at our institution between 2000 and 2012 were reviewed. Patients with postoperative arthrofibrosis were identified. The mean age of those who developed arthrofibrosis was 62 years, with a mean BMI of 32 kg/m^2. 55% were female. Mean follow-up was 5 years.

RESULTS: From 2000 to 2012, 571 patients (5.8%) developed arthrofibrosis with 272 (2.8%) being treated with a MUA. This was similar to the previous decade, where the rate of arthrofibrosis was 5.4%, with 2.9% requiring MUA. The only identifiable risk factor for MUA in the past decade was previous knee operation ($p= 0.003$). Age, gender, and BMI were not significant risk factors. With contemporary MUA, mean flexion improved from 61º to 109º, reflective of a mean 49º gain ($p < 0.001$). However, a subset of 14 (5.1%) patients failed to maintain at least 90º of flexion after MUA or gained less than 20º of flexion after MUA.

DISCUSSION: Despite advances in mean ROM after TKA in most contemporary compared to historical series (probably due to better surgical technique, implant design, and pain control), the incidence of arthrofibrosis following primary TKA has remained unchanged over the past 2 decades. Previous knee operations were the only identified risk factor. New strategies are needed to understand the etiology of this problem and address this persistent small but highly negatively impacted group of patients.

SUMMARY: The incidence of arthrofibrosis (6%) following primary TKA has remained unchanged in the past 2 decades, with 3% requiring MUA and 5.1% with a persistent unsatisfactory result despite MUA.

The Patient's Native Tibial Slope is the Ideal Target in Cruciate-Retaining Total Knee Arthroplasty

Abstract ID: Poster 020

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INTRODUCTION: Increased attention is being paid to component alignment in total knee arthroplasty (TKA). The majority of focus has been on the coronal plane and subsequently less is understood about TKA alignment in the sagittal plane, particularly with respect to tibial slope. The purpose of this study is to evaluate the effect of tibial component slope on patient outcomes after cruciate retaining TKA.

METHODS: A retrospective review of 260 consecutive primary TKAs was performed. All procedures were performed with identical surgical technique, identical implants, and similar perioperative protocols. All TKAs were a cruciate-retaining (CR) design. Digital radiographic evaluation was performed specifically measuring native tibial and the implanted tibial component slope. Clinical outcome measures (UCLA Score, new Knee Society Score) were obtained preoperatively, 4 weeks, 4 months, and annually thereafter. Statistical analysis correlated tibial component slope with clinical outcomes and $p<0.05$ considered significant.

RESULTS: The cohort consisted of 195 females (63.5%) and 95 males (36.5%) with a mean age of 65 and a mean BMI of 34. TKAs with tibial implant slope that more closely approximate native slope are associated with greater absolute KSS satisfaction and function scores ($p=0.002$, $p=0.001$) and greater improvement in KSS satisfaction and function scores ($p=0.014$, $p = 0.059$) compared to those that substantially deviate from native slope. Similarly, greater improvement in patient UCLA activity scores was positively correlated with a closer approximation of the native tibial slope ($r=0.2$; $p=0.04$).

CONCLUSION: Multiple patient-reported outcome measures were optimized with larger absolute scores and greater improvement from preoperative values in patients whose tibial component more closely approximated their native proximal tibial inclination.

SIGNIFICANCE: Surgeons should target the patient’s native tibial slope in cruciate-retaining TKA to optimize patient function and outcomes. Modalities that enhance implant placement accuracy, such as computer navigation or robotic-assisted surgery, should be considered in the quest to optimize patient outcomes.

National Trends of Blood Transfusion After Primary Total Knee Arthroplasty

Abstract ID: Poster 021

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INTRODUCTION: The joint commission cites blood transfusions as one of the five most overused hospital procedures. In response, hospital policies have encouraged surgeons to minimize blood transfusion. Furthermore, reducing transfusions may be a potential source for reducing costs. The purpose of this study was to assess recent national trends in blood transfusion after primary total knee arthroplasty (TKA).

METHODS: ICD-9 procedure codes were used to search the National Hospital Discharge Survey database (NHDS) for patients admitted to U.S. hospitals after primary TKA between 2001-2010. Data regarding blood transfusions, patient demographics, in-hospital adverse events, and discharge disposition were gathered. Statistical analysis included linear regression with Pearson's correlation coefficient (r), Student's t-test, and chi-square analysis with a significance level of 0.05.

RESULTS: 33,066 patients admitted for a primary TKA were identified. Of these, 5160 patients (15.6%) required a transfusion during the same admission. Transfusion after TKA demonstrated a negative correlation with time (r=-0.844), decreasing from an average rate of 16.7% between 2001-2005 to 14.1% between 2006-2010 ($p<0.01$). Of the TKA patients that were transfused, 1503 (29.1%) received previously collected autologous blood. Autologous transfusions demonstrated a strong negative correlation with time (r=-0.983), decreasing from 43.6% of all THA transfusions in 2001 to 8.9% in 2010. Conversely, allogeneic transfusions increased over time (r=0.631).

The transfused TKA patients were more likely to be female (73.3% vs. 63.3%, $p<0.01$), older (69.6 vs. 66.2 years, $p<0.01$), and had more medical co-morbidities (5.49 vs. 4.88, $p<0.01$) than the non-transfused patients. Patients who had a TKA performed in a hospital with ≥ 200 beds were more likely to be transfused than those in hospitals with ≤ 199 beds (16.2% vs. 14.6%, $p<0.01$). Transfused patients had a longer hospitalization (4.11 vs. 3.63 days, $p<0.01$) and a higher rate of discharge to a rehabilitation facility (30.4% vs. 26.3%, $p<0.01$). Additionally, transfused patients had significantly higher rates of both deep vein thrombosis (0.52% vs. 0.33%, $p=0.045$), and pulmonary embolism (0.68% vs. 0.37%, $p=0.002$). No significant difference in mortality was found ($p=0.629$).

DISCUSSION/CONCLUSION: This study demonstrates that the overall blood transfusion rate after TKA is decreasing. Interestingly, there is an increase in the use of allogeneic rather than autologous blood for transfusion. Blood transfusions after TKA were associated with longer hospitalizations and a less favorable discharge disposition. The transfusion rate following TKA may be a significant factor to consider as payments become bundled with the roll out of the Affordable Care Act.

Postoperative Pain Management After Primary Knee Arthroplasty: The Value of Liposomal Bupivacaine

Abstract ID: Poster 022

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INTRODUCTION: Numerous multimodal pain protocols have been drafted to improve long-acting postoperative analgesia. The purpose of this study was to compare the postoperative pain scores, time to ambulation, and overall narcotic usage between patients who received either a femoral nerve block utilizing bupivacaine vs. a periarticular extended-release liposomal bupivacaine injection in patients undergoing primary total knee arthroplasty (TKA).

METHODS: 597 primary TKAs performed between September 2012 and August 2014 were retrospectively reviewed. Preoperatively, all patients received celecoxib, oxycontin, and topical scopolamine. Intraoperatively, patients either received a single dose bupivacaine femoral nerve block along with 30 ml 0.25% Marcaine periarticular injection (Group A) or 60 ml periarticular injection alone (20 ml liposomal bupivacaine, 30 ml 0.25% Marcaine, 10 ml saline) (Group B). Postoperatively, all patients received celocoxib, oxycodone, and were provided narcotics as needed. All patients received the identical preoperative and postoperative scheduled analgesia among both groups. The postoperative pain scores, narcotic usage, and time to ambulation were collected from the electronic medical record.

RESULTS: 325 patients were in Group A, while 272 were in Group B. There was no difference in sex, race, or BMI between groups. Group B demonstrated a decreased need for breakthrough pain medication (16.9% vs. 36.3% $p<0.001$), decreased pain scores 12 hours postoperatively (3.2 vs. 3.6 $p=0.003$), and an earlier time to ambulation ($p=0.017$). No difference in hospital length of stay or pain score at 24 hours postoperatively were seen.

DISCUSSION/CONCLUSIONS: Liposomal bupivacaine resulted in a decreased need for breakthrough pain medication, improved pain scores at 12 hours postoperatively, and an earlier time to ambulation compared to a combined femoral nerve block and periarticular Maracine injection. Liposomal bupivacaine should be considered as one modality to improve postoperative analgesia following primary total knee arthroplasty.

Efficacy of Intra-Articular Platelet Rich Plasma Injections in Knee Osteoarthritis: A Systematic Review

Abstract ID: Poster 023

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BACKGROUND: Platelet-rich plasma (PRP) has emerged as a potentially successful, non-operative injection treatment for patients with symptomatic knee OA.

PURPOSE: To determine: (1) if PRP injection is able to significantly improve validated patient-reported outcomes in patients with symptomatic knee OA at 6 and 12 months post-injection; (2) if there is a significant difference in outcomes between PRP and corticosteroid injections, PRP and viscosupplementation, or PRP and placebo injections at 6 and 12 months post-injection; (3) the similarities and differences in outcomes based on the PRP formulations used in the analyzed studies.

METHODS: PubMed, Cochrane Central Register of Controlled Trials, SCOPUS, and Sport Discus were searched for English language level I evidence human in vivo studies focused on treatment of symptomatic knee OA with intra-articular PRP compared with other options, with a minimum of 6 months follow-up. Outcomes of pre- and post-PRP conditions and PRP vs. HA were compared using two-proportion z-tests. Heterogeneity in outcome scores precluded meta-analysis. Nonetheless, a best evidence synthesis was performed. A quality assessment of all articles was performed using the MCMS.

RESULTS: Six articles (739 patients, 817 knees, average MCMS 83.3/100) were analyzed, including 289 males with mean age and follow-up of 59.9 years and 38 weeks per patient, respectively. All studies showed significant clinical and statistical improvements in pain, physical function, and stiffness, with PRP according to WOMAC and IKDC scores. All but one study showed significant differences between PRP and HA or PRP and placebo in pain and function. Post-PRP WOMAC scores were significantly better than post-HA at 3-6 months ($p=0.0008$) and 6-12 months ($p=0.0062$).

CONCLUSIONS: In patients with symptomatic knee OA, PRP injection results in significant improvements up to 12 months post injection. WOMAC scores are significantly better following Leukocyte-poor PRP vs. HA at 3 to 12 months post injection.

Revision Total Knee Arthroplasty for Frank Patellar Dislocation: Are We Any Better?

Abstract ID: Poster 024

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BACKGROUND: Patellar dislocation is a devastating complication following total knee arthroplasty (TKA). There is a paucity of data concerning the outcomes of revision surgery for patellar dislocation. The purpose of this study was to assess the outcomes of revision TKA performed specifically for frank patellar dislocations.

METHODS: We retrospectively reviewed 27 revision TKAs (25 patients) performed at our institution for patellar dislocation between 1985 and 2010. Clinical outcomes, radiographic results, survivorship, and complications of the revision surgery were reviewed. Mean age at revision surgery was 72 years, with 48% being male. Mean BMI was 26 kg/m^2. The mean follow-up was 7 years.

RESULTS: While Knee Society (KS) pain scores significantly improved from 49 to 72 ($p<0.0001$), KS functional scores did not significantly improve. Following revision, patellar tilt significantly improved from 40° to 10° ($p<0.0001$). 56% (15/27) had internal rotation of the femoral and/or tibial components, mandating a femoral-tibial revision. Of the 12 patients without internal rotation, 7 required full revisions due to aseptic loosening or instability that was discovered intraoperatively, 3 had patellar revisions with lateral releases, and 2 had only soft-tissue procedures without any component revision. Seven knees developed recurrent dislocations at a mean of 18 months after revision surgery. The survivorship free of patellar dislocation after revision was 88% at 1 year and 75% at 5 years. Five of the 7 recurrent dislocations had femoral and/or tibial component revisions, while two had a patellar revision and medial soft tissue imbrication only. As such, the 5-year survivorship free of recurrent dislocation was 80% for those who had all components removed, compared to 60% for those who did not undergo tibiofemoral component revision, but this did reach significance ($p=0.4$).

CONCLUSION: Patellar dislocation is a relatively uncommon, but devastating, complication after TKA. Revision TKA for patellar dislocation leads to improved radiographic outcomes and improvement in pain with survival free of subsequent patellar dislocation of 75% at 5 years. There is no significant difference in recurrent dislocation rates between those who underwent femoral and/or tibial component revisions and those who did not have femoral and/or tibial component revision.

Utility and Reliability of Fluoroscopic Images in Determining Clinically Relevant Loosening in Total Knee Arthroplasty

Abstract ID: Poster 025

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INTRODUCTION: Pain after total knee arthroplasty (TKA) may be secondary to implant loosening, which is challenging to diagnose on standard radiographs. Fluoroscopic images that enhance the implant interfaces are often obtained, but their utility and reliability has not been studied. We sought to determine if these fluoroscopically guided images improved the sensitivity, specificity, intraobserver, and interobserver reliability of determining clinically relevant loosening in TKA components compared to standard radiographs.

METHODS: 60 standard radiographs and 60 fluoroscopically enhanced images were retrospectively obtained from 60 patients with painful TKAs undergoing revision. 30 knees were revised for aseptic loosening and 30 knees for other indications, most commonly instability. Implant stability was determined intraoperatively and recorded. Standard radiographs and fluoroscopic images obtained within 6 months of revision surgery were collected and randomized. Two reviewers blinded to the randomization independently determined whether each tibial and femoral component was clinically loose. Two weeks later, the images were again randomized and reviewed a second time. We then analyzed the sensitivity, specificity, and intra- and inter-observer reliability.

RESULTS: Enhanced fluoroscopic images improved the detection of clinical loosening in tibial components compared to standard radiographs (87.5% vs. 74.5%, respectively, p=0.002). Sensitivity in detecting femoral component loosening was poor overall and was not improved by fluoroscopic images vs. standard radiographs (57.5 vs. 57%, respectively, p=0.9). For the tibial component, specificity was not improved by fluoroscopic images over standard radiographs (89% vs. 88.5% respectively, p=0.9). However, specificity for the femoral component was significantly worse in fluoroscopic vs. standard radiographs (81% vs. 87% respectively, p=0.03). Fluoroscopic images did not significantly improve mean interobserver reliability vs. standard radiographs for the tibial component (kappa = 0.65 vs. kappa=0.61, p=0.4) or femoral component (kappa=0.40 vs. kappa=0.42, p=0.9). Fluoroscopic images improved intraobserver reliability in the femur vs. standard radiographs (mean kappa = 0.74 vs. kappa = 0.51), but was nearly equivalent for the tibial component.

CONCLUSION: Fluoroscopically guided radiographs significantly increased the sensitivity of detecting tibial component loosening. The detection of femoral component loosening was poor for both imaging types, but fluoroscopic radiographs may increase the false positive rate for detecting femoral loosening. Interobserver and intraobserver reliability was not significantly improved with the use of fluoroscopic images.

SUMMARY: Compared to standard radiographs, fluoroscopically-guided images improved the detection of tibial component loosening, but were not beneficial in the evaluation of femoral component loosening.

Incidence and Significance of Noise Generation in Modern Knee Arthroplasty

Abstract ID: Poster 026

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BACKGROUND: Numerous reports have focused on patients' perceptions of noise in knee arthroplasty procedures for both total (TKA) and unicondylar (UKA) arthroplasties. While it is known that many patients notice noise following knee arthroplasty, the incidence and clinical significance of this is unknown. This study was undertaken to determine the incidence of noise generation following TKA/UKA with current designs and to determine if it is of clinical significance.

METHODS: A national multicenter study was undertaken utilizing previously published methodology. Each center contributed data on a specific modern knee arthroplasty design. Patients were questioned whether they perceived noises coming from their knee in the past 30 days (grinding, popping, clicking, or other noise). Data was collected by an independent third party survey center, blinded to implant type, as part of a larger questionnaire assessing patient satisfaction, residual symptoms, and activity levels. Patient age, gender, minority status, education level, income, and activity level (pre-arthritic UCLA scores) were considered potential confounders and accounted for using multivariate logistic regression analyses.

RESULTS: 1664 participants were included (1200 TKAs, 464 medial UKAs). TKA implant types included cruciate retaining, posterior stabilized, mobile bearing, high flex, and gender. UKA implant types included mobile bearing and fixed bearing. Patients categorized the occurrence of noise as never, rarely, sometimes, often, or extremely often. 30% reported noise generation from their knee more than rarely. The incidence of noise generation was not related to age, gender, minority status, education level, income, or activity level. The incidence of noise generation was higher for TKAs vs. UKAs ($p<0.0001$). Among UKAs, the mobile bearing UKAs showed a strong trend toward lower incidence of noise generation compared to fixed bearing ($p=0.059$). Within the TKA designs, cruciate retaining exhibited less noise than all other designs considered ($p<0.008$). Noise generation was of clinical significance in patients who reported "no noise" as they reported less pain ($r=0.349$), stiffness ($r=0.298$), and swelling ($r=0.274$), and were more likely to report they were satisfied ($r=0.200$) and their knee felt normal to them ($r=0.233$; $p<0.0001$ for all).

CONCLUSION: Patient perception of noise generation following modern knee arthroplasty is surprisingly common, and is of clinical significance. Patients should be informed there is a substantial chance they will perceive noise after knee arthroplasty and occurrence of noise may be associated with somewhat higher reports of residual symptoms.

A Retrospective Review of Rotating Hinge Knee Arthroplasty Outcomes

Abstract ID: Poster 027

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INTRODUCTION: Hinged knee replacements have historically shown mixed results. However, newer designs have shown potential for better outcomes. The purpose of this study is to evaluate patient outcomes in those that have received a modern generation rotating hinge knee (RHK) prosthesis. Patient satisfaction, implant survival, as well as causes for failure will be assessed.

METHODS: We performed a retrospective review of 43 patients who underwent an RHK for either a complex primary, or revision total knee arthroplasty (TKA) from four different fellowship-trained arthroplasty surgeons. Patient outcomes were assessed using the 12-Item Short Form Health Surveys (SF-12) physical and mental component summary (PCS/MCS), knee society scores (KSS) for pain and function as well as visual analog scores (VAS) for pain. Failure was defined as a return to the operating room for any reason or radiographic evidence of implant loosening. A two-tailed t-test was performed for each variable.

RESULTS: 32 females and 11 males with an average age of 66.7 years (range 36-85) underwent RHK arthroplasty and were followed for a mean of 4.5 years (range 2-9.6 years). 35 were revisions and 8 were primaries with severe deformity or ligamentous laxity. Average preoperative VAS score was 7.4. In total, 8 patients (18.6%) required a procedure on the affected knee; including 2 for extensor allograft failure, 1 for fracture of hinge post, 1 for fracture of tibial component, 1 for manipulation, 1 for deep infection, 1 for a superficial abscess, and 1 for peroneal nerve decompression. As of most recent chart review, KSS (pain) improved from 42.8 to 76.6, KSS (function) 19.2 to 31.8, SF-12 PCS 28.3 to 31.9, and SF-12 MCS 47.8 to 50.4 (CI 95%, $p<.05$ for all outcomes) compared to preoperative patient data.

CONCLUSION: Hinge-knee replacements are typically reserved for complex cases and have higher incidences of complications. Overall, most patients demonstrated an improvement in their knee function postoperatively. This procedure is a viable option for these difficult situations, and this contemporary design has an acceptable complication rate for the appropriately indicated patients.

Introduction of New Technology: Adoption of Computer and Robot Assistance in Knee Arthroplasty

Abstract ID: Poster 028

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INTRODUCTION: The development and implementation of new technologies are essential to advance any field of medicine. It is important to understand how these technologies are being adopted by surgeons and patients. The purpose of this study was to evaluate rates of adoption of computer assisted orthopedic surgery (CAOS) and robot assisted orthopedic surgery (RAOS) during total knee arthroplasty (TKA) and unicompartmental knee arthroplasty (UKA) over the last decade.

METHODS: Four large national databases (Humana Inc., Medicare Standard Analytic Files, National Inpatient Sample, ING Claims Database) were reviewed using ICD-9 and/or CPT codes to evaluate trends in adoption of CAOS and RAOS amongst orthopedic surgeons during both TKA and UKA over the years of 2005 to 2014. The number of TKA and UKA performed with CAOS and RAOS were independently identified from each dataset and compared to the total number of primary TKA and UKA performed during those years in the respective datasets.

RESULTS: CAOS was utilized for 146,308 TKA and 1,882 UKA representing 4.8% of 3,030,848 TKA and 7.0% of 26,916 UKA included in these datasets. Rates of CAOS usage varied across datasets with a range of 4.5-7.7% for TKA and 4.9-9.7% for UKA. Rates of CAOS for TKA began to plateau in 2008 and stayed approximately 6-8% through the remaining years. In contrast, adoption of CAOS for UKA has steadily increased approximately 2% per year over this same time interval.

Robotic assistance was utilized for 8,006 TKA and 337 UKA representing 0.3% of 3,061,472 TKA and 1.8% of 18,793 UKA included across these datasets. Rates of RAOS usage was less than 1% for all TKA and ranged from 0.23-4.8% for UKA with a 20-fold increase for the only dataset with commercial insurance (Humana Inc.).

CONCLUSIONS: Adoption of CAOS and RAOS has been relatively low for TKA (CAOS: 4.8%, RAOS: 0.3%) and UKA (CAOS: 7.0%, RAOS: 1.8%). These technologies are utilized more frequently for UKA, especially RAOS for UKA within the dataset including private/commercial insurance. Usage data, such as this study, is the first step in determining the value of these new technologies.

SHOULDER

Is Previous Non-Arthroplasty Surgery a Risk Factor for Periprosthetic Infection in Primary Shoulder Arthroplasty?

Abstract ID: Poster 029

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INTRODUCTION: Revision shoulder arthroplasty (SA) has been reported to have a higher risk of infection compared to primary SA. However, whether a prior non-arthroplasty surgery could potentially lead to higher risk of infection after SA remains unknown. The purpose of this study is to determine the risk of periprosthetic infection after primary SA in patients who underwent previous non-arthroplasty shoulder surgery and compare it to those who did not have previous surgeries.

METHODS: All patients who underwent primary SA at our institution between 1970 and 2012 were included in this study. The cohort consisted of 4641 patients treated with 2913 total SA, 1260 hemiarthroplasties, and 468 reverse SA. 872 (19%) patients had undergone prior surgery. Patients who had undergone prior shoulder surgery vs. patients without previous surgery were compared for postoperative periprosthetic infection. Univariate and multivariable analyses were used.

RESULTS: Deep postoperative infection of the shoulder was diagnosed in 71 patients (1.53%). Of the 872 patients who had undergone previous surgery, 23 (2.64%) developed a deep postoperative infection. However, of the 3764 patients who did not have previous shoulder surgery, 48 patients (1.28%) sustained deep shoulder infection. This difference was significant in both the univariate (p=0.026) and multivariate analyses (p=0.0341).

When specific non-arthroplasty surgeries were analyzed individually, rotator cuff repair, acromioplasty, capsular repair, debridement for non-septic reasons, or debridement for septic reasons were all found to be significantly associated with more periprosthetic infections (p=0.0472, p=0.0200, p=0.0005, p=0.0068, and p=0 .0490, respectively). The infection rate was higher in patients who had undergone previous open reduction and internal fixation; however, this did not reach significance (p=0.6748).

CONCLUSIONS: The risk of infection after primary SA in patients who underwent previous non-arthroplasty related surgery is significantly higher than in those who did not. This finding should be discussed with the patients prior to their surgery and potential preoperative and intraoperative work-up should be undertaken to these patients.

Generic Targeting Guides Place Revision Glenoid Components in More Anatomic Version Than Traditional Techniques

Abstract ID: Poster 030

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INTRODUCTION: Glenoid component positioning can be more difficult in the revision shoulder arthroplasty setting, but remains an important goal. The purpose of this study was to compare postoperative glenoid component version in revision total shoulder arthroplasty (TSA) and reverse total shoulder arthroplasty (RTSA) using traditional instrumentation compared with a generic reusable glenoid targeting guide.

METHODS: The postoperative radiographs of 50 shoulders undergoing revision shoulder arthroplasty were retrospectively reviewed in a randomized fashion by an independent reviewer. Twenty-one components were placed using traditional instrumentation and the remaining 29 were placed with a targeting guide placed down the anterior glenoid neck to direct guidewire placement in anatomic version. Using Friedman's technique, glenoid component version was measured on the best available postoperative axillary lateral radiograph. Standard statistical analysis was performed. Differences with $p<0.05$ were considered statistically significant.

RESULTS: The average deviation in component version from anatomic for the traditional technique group was 8°, compared to 5° in the targeting guide group ($p=0.03$). In revision to TSA, the average deviation in version was 10° in the traditional group and 3° in the targeting guide group ($p=0.01$). There was not a significant difference in revision to RTSA, with an average deviation in version of 8° in the traditional group and 6° in the targeting guide group ($p=0.45$). Glenoid components in obese patients (BMI>30, 58% of patients) were in more anatomic version following placement with the targeting guide when compared to traditional instrumentation (5° vs. 9°, $p=0.04$). There were no significant differences between techniques in glenoids with greater than 15° of preoperative retroversion, TSA conversion to RSTA, or post-traumatic revision.

DISCUSSION AND CONCLUSION: In the revision arthroplasty setting, glenoid components placed with the targeting guide were significantly more accurate in version when compared to traditional instrumentation, particularly when revising to anatomic TSA. The targeting guide was also useful in the obese population, which was over half of our cohort. This suggests that excess soft tissue, whether post-traumatic scarring or secondary to obesity, can make glenoid placement using traditional techniques more prone to error.

Outcomes of the Reverse Prosthesis in Revision Shoulder Arthroplasty

Abstract ID: Poster 031

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PURPOSE: The purpose of this study was to examine all revision reverse shoulder arthroplasties performed at our institution over a 6-year period.

METHODS: We reviewed all revision RSAs performed at our institution between 2005-2011. Overall, 154 patients were included in our study, with average age at the time of revision surgery of 70.0 years and the average clinical follow-up of 3.3 years (2-8). There were 63% females, an average BMI 30.6, as well as 18 smokers, 25 with diabetes mellitus, and 10 with rheumatoid arthritis. Prior implants utilized in the primary setting included anatomic (n=52), reverse (n=23), and hemiarthroplasties (n=79). Cement was utilized in the primary surgery in 38 (25%) cases.

RESULTS: There were 23 (15%) of the patients who experienced postoperative complications requiring revision surgery for glenoid loosening (n=12), instability (n=6), humeral loosening (n=1), component fracture (n=2), and infection (n=2). The 2- and 5-year survival rates were 86% and 81%, respectively. The survival free of glenoid loosening at 2 and 5 years was 92% and 90%, respectively. There were 13 additional postoperative complications not requiring revision surgery, including dislocations (n=6), superficial infection (n=2), and periprosthetic fracture (n=5). Patients undergoing a revision of a previous anatomic arthroplasty (HR 3.64, P=0.003) and those with postoperative instability (HR 8.42, P<0.0001) were at increased risk of revision surgery. Overall, patients experienced excellent overall pain relief, 29% of patients reporting moderate or severe pain postoperatively compared to 94% preoperatively (p<0.01). Shoulder abduction and external rotation improved from 46° and 18° preoperatively to 112° and 35°, respectively (p<0.01). 75% of the young patients were very satisfied. The average postoperative ASES and simple shoulder test (SST) score were 64 and 5.9, respectively. At last radiographic follow-up, 24 (16%) had glenoid lucency, with 16 (10%) classified as grade III or higher. Patients with a history of smoking (HR 5.38, P=0.008), diabetes (HR 3.66, P=0.03), and undergoing a revision of a previous anatomic shoulder arthroplasty (HR 6.21, P=0.005) increased the rates of glenoid loosening.

SUMMARY POINTS: Revision reverse shoulder arthroplasty is a successful procedure in the revision setting. At an intermediate follow-up period, there are reasonable implant survival rates, with a relatively high rate of glenoid loosening, especially in patients with a history of tobacco use and diabetes. RSA provides a reasonable option in the revision setting to relieve pain and restore shoulder function and stability.

Does Using a Shorter Humeral Stem Influence Outcome in Revision Reverse Shoulder Arthroplasty?

Abstract ID: Poster 032

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PURPOSE: With the preliminary success of the reverse prosthesis in the revision setting, there are many technical considerations surgeons must consider when using the reverse prosthesis. In an attempt to preserve humeral bone stock, one technique involves revising a long stem humeral component to one with a shorter stem. Given the paucity of information about utilizing shorter stems, the purpose of this study was to examine the outcomes of revision reverse arthroplasty utilizing short bone preserving humeral components.

METHODS: We reviewed all revision RSAs performed at our institution between 2005-2011 in which a long or standard length stem was revised to a short humeral component. In this 6-year period, 20 patients were revised to a short reverse humeral components. The mean age was 75 years, with 60% females, and mean BMI 28.1. There were 2 smokers and 3 with diabetes mellitus. Prior implants utilized in the primary setting included anatomic (n=9) and hemiarthroplasties (n=11). Seven patients had a history of a proximal humerus fracture in the past. Cemented humeral components were utilized in the primary surgery in 6 of the cases.

RESULTS: At a follow-up of 2.4 years (2.0-4.4), there were 4 (20%) who required revision surgery, all 4 for glenoid component loosening. No patients required revision surgery for humeral loosening. The 2- and 5-year survival estimates were 80% and 80%. There were six intraoperative fractures, and one patient experienced a nondisplaced greater tuberosity fracture at 1.5 years postoperatively treated nonoperatively. There were no dislocations or infections. No analyzed factors influenced the rate of revision surgery. Overall, patients experienced excellent overall pain relief, 30% of patients reporting moderate or severe pain postoperatively compared to 100% preoperatively ($p<0.01$). Shoulder abduction and external rotation improved from 45° and 13° preoperatively to 103° and 36°, respectively ($p<0.01$). 85% of the young patients were very satisfied. The average postoperative ASES and simple shoulder test (SST) score were 55 and 5.6, respectively. At last radiographic follow-up, 1 (5%) had grade II (out of IV) humeral lucency. No factors had an impact on the rates of humeral loosening.

SUMMARY POINTS: Preserving bone stock through conversion to a shorter reverse humeral stem in the revision setting is a reasonable option with good medium-term results and low rates of humeral complications. Utilizing the shorter stem components provides adequate stability and rates of humeral component ingrowth.

Acromial Fractures in Reverse Shoulder Arthroplasty. A Clinical and Radiographic Analysis.

Abstract ID: Poster 033

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INTRODUCTION: Acromial fractures following reverse shoulder arthroplasty (RSA) are observed in 0.8% to 10.2% of cases. Previous reports have attempted to determine the risk factors and best therapeutic approach for this complication as well as its associated outcome. However, the answers to these questions remain unclear. The purpose of our study is to review our experience with RSA and to determine the incidence of acromial fractures, potential risk factors for such fractures, and their associated outcome.

METHODS: 1082 shoulders that underwent primary reverse shoulder arthroplasty at our institution between August 2004 and December 2013 were screened for postoperative acromial fractures. Twelve patients were included and a case matched control group of 48 patients who underwent RSA was created. Outcome measures including pain and range of motion were reported. Clinical and radiographic risk factors were assessed.

RESULTS: Among the 1082 shoulders which underwent RSA between August 2004 and December 2013, 12 (1.11%) sustained a postoperative acromial fracture. According to the Levy classification, 9 (75%) fractures were type I, and 3 (25%) were type II. Four (31%) of the fractures were displaced. All the fractures were initially treated non-operatively. Compared to controls, the fracture group tended to be less satisfied with their outcome, despite equivalent ASES scores, pain scores, and range of motion. None of these differences were statistically significant. Of all comorbidities analyzed, osteoporosis was the only one that was significantly associated with acromial fractures ($p=0.027$). However, statistically significant findings included a longer operative time, smaller lateral offset of the greater tuberosity, greater arm lengthening, and a thinner acromion in the fracture group.

CONCLUSION: In summary, postoperative acromial fractures appear to be incidental lesions with little influence on the outcome after RSA. The combination of a thin acromion and superior migration of the humeral head increase the risk of acromial fracture after lowering and medializing the center of rotation of the joint by a reverse shoulder arthroplasty. A less medialized design would not verticalize excessively the line of pull of the deltoid on the acromion and could, therefore, decrease the risk of this specific complication.

Is Shoulder Arthroplasty an Option for Charcot Arthropathy?

Abstract ID: Poster 034

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INTRODUCTION: Charcot arthropathy is a rare cause of debilitating joint destruction. Arthroplasty is occasionally considered for Charcot arthroplasty affecting the knee joint, but less commonly considered in the shoulder joint. Shoulder arthroplasty in Charcot arthropathy is challenging secondary to marked and progressive bone loss, soft-tissue destruction affecting the capsule and rotator cuff, predisposition to superinfection, lack of protective sensation, and altered muscle control. To our knowledge, no studies in the English literature have evaluated the outcomes, complications, and survivorship of shoulder arthroplasty in Charcot arthropathy.

METHODS: Between January 2000 and December 2011, 10 shoulders with Charcot arthropathy were treated with shoulder arthroplasty at our institution. Shoulders with preoperative or intraoperative evidence of infection were excluded. All shoulders were followed for a minimum of two years or until reoperation.

RESULTS: Shoulder arthroplasty reliably improved pain in this population. However, gains in range of motion were not as substantial, with mean abduction at follow-up of only 105°. External rotation improved from 20-43°. Subjectively, 6 of the 10 patients rated the result as much better or better. Two shoulders underwent revision to a reverse TSA at an average of 5 months after index arthroplasty.

CONCLUSION: Shoulder arthroplasty for the treatment of the sequelae of a Charcot joint leads to substantial pain relief. However, patients have less improvement in range of motion, subjective satisfaction, and satisfactory results compared with those shoulders treated for osteoarthritis. The relative indications of hemiarthroplasty, total shoulder arthroplasty, and reverse shoulder arthroplasty for this particular condition continue to evolve.

Males With Glenohumeral Arthritis Have Worse Glenoid Pathology Than Females Despite Similar Pre-Morbid Morphology

Abstract ID: Poster 035

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Patients with glenohumeral arthritis exhibit a wide range of glenoid pathology and different patterns of glenoid bone loss. The difference in pre- and post-morbid morphology between genders has not been previously examined. We hypothesized that men and women present with different glenoid pathology and differences in pre-morbid factors that may influence the severity of disease.

METHODS: We evaluated 106 patients undergoing total shoulder arthroplasty (TSA), and patients were grouped according to gender (70 males, 36 females). Each patient underwent a computed tomography (CT) scan of the entire scapula and the proximal humerus with 0.6 mm slices followed by three-dimensional (3D) reconstruction. The plane of the scapula was defined by three points – the center of the glenoid, the inferior angle, and the trigonum scapulae – and the plane of the glenoid was defined by three points on the rim of the glenoid, taking care to avoid peripheral osteophytes. A best fit sphere was placed on the humeral head, thus defining the center of rotation. These landmarks defined version, inclination, and subluxation of the humeral head in the plane of the glenoid and the plane of the scapula. Posterior subluxation >5% of the head diameter in each plane was considered significant. The morphology of the pre-morbid glenoid was defined by the glenoid vault model, a validated 3D representation of the shape and position of the normal glenoid (Figure 1).[1] Glenoids were classified according to the Walch classification by consensus reads of two experienced shoulder surgeons. Critical shoulder angle (CSA) was measured on true anterior-posterior radiographs. We compared continuous variables with student's t-tests and categorical data with chi squared comparisons, with $p<0.05$ as the threshold for significance.

RESULTS: Males had higher retroversion (-15.2°±8.4 for males and -10.9°±9.0 for females, p=0.016), and acquired retroversion relative to premorbid version (7.7°±6.6 and 4.4°±6.5, p=0.015). There was a trend toward more Walch B and C glenoids in males (44% A, 50% B, 6% C) than in females (61% A, 39%B, 0% C) (p=0.14), and a trend towards a higher rate of subluxation in the glenoid plane in males (70%) than females (53%) (p=0.12). However, there was no difference in premorbid glenoid version (-7.6°±5.3 and -6.6°±4.0, p=0.32), CSA (27.8°±4.5 and 29.1°±5.8, p=0.21), BMI (31.7±6.2 and 32.6±6.5, p=0.50), side affected (dominant side in 44% and 44%, p=0.99), or age (64.2±7.9 and 66.8±8.8 years, p=0.12). Overall, mean premorbid version was -7.2°±4.7, and mean CSA was 28.2°±5.0.

CONCLUSIONS: Males undergoing TSA present with worse glenoid pathology than females, but there are no differences in other variables that may influence the severity of disease. Though CSA has been previously shown to influence whether patients develop glenohumeral

arthritis, our findings suggest that variables not measured in this study, such as activity level or physical demand, likely play an important role in the severity of disease. Furthermore, mean premorbid version of the arthritic glenoid was -7° and CSA was 28°.

[1]Scalise JJ, Codsi MJ, Bryan J, Iannotti JP. The three-dimensional glenoid vault model can estimate normal glenoid version in osteoarthritis. J Shoulder Elbow Surg. 2008 May-Jun;17(3):487-91. doi: 10.1016/j.jse.2007.09.006. Epub 2008 Feb 20.

Click here to view Figure 1

Posterior Augmented Glenoid Component Compared to Reverse Ball-and-Socket for Glenoid Retroversion in Total Shoulder Arthroplasty

Abstract ID: Poster 036

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INTRODUCTION: Over the past several years, the incidence of total shoulder arthroplasty (TSA) has continued to increase. These procedures have demonstrated good long-term success and implant survivorship. However, posterior glenoid bone loss and glenoid retroversion remains a difficult problem in TSA, and despite a variety of implant options and surgical techniques none has been clearly delineated as superior. The purpose of this study was to compare functional outcomes and patient satisfaction in a series of patients with bilateral glenoid retroversion that received a posterior augmented, all-polyethylene glenoid component anatomic TSA in one shoulder and a reverse ball-and-socket TSA in the contralateral shoulder.

METHODS: A retrospective review was performed of patients who had undergone staged bilateral TSA for osteoarthritis with glenoid retroversion, one side with posterior augmented glenoid component, and the contralateral shoulder with reverse TSA, performed by a single shoulder and elbow fellowship-trained orthopedic surgeon. Preoperative glenoid version, preoperative and postoperative simple shoulder test (SST), visual analog scale (VAS) pain score, and forward elevation (FE), external rotation (ER), and internal rotation up the back (IR) range of motion data were collected, along with postoperative subjective shoulder value (SSV) and patient satisfaction.

RESULTS: Three patients met inclusion criteria, with a mean age of 67.3 years and mean follow-up of 33.8 vs. 18.6 months ($p=0.05$) for the posteriorly augmented glenoid component and reverse TSA, respectively. The mean glenoid retroversion was 29.4° vs. 28.6° ($p=0.84$). Improvements in the posteriorly augmented glenoid vs. reverse TSA were: SST (4.7 to 10.3 vs. 3.7 to 9.7), VAS pain score (7.7 to 1.0 vs. 7.3 to 1.3), FE (100.0 to 160.0 vs. 90.0 to 146.7), ER (0.0 to 38.3 vs. 6.7 to 35.0), and IR (L4 to T11 vs. L5 to T12). Mean postoperative SSV was 94.7% vs. 93.3%, and all three patients were “very satisfied” with their results in both shoulders. All values demonstrated statistically significant improvement from preoperative to postoperative time periods in both techniques ($p<0.05$), but there was no statistical significance found in the level of improvement when comparing the two techniques.

DISCUSSION AND CONCLUSION: In the setting of excessive glenoid retroversion in patients undergoing TSA, the utilization of a posterior augmented glenoid component or reverse TSA both result in comparable, significant improvements in patient-assessed function, objective clinical measures, and patient satisfaction, and should both be considered as viable options for this difficult problem.

SPINE

The Effect of Blood Transfusion on Short-Term Complications After Adult Spinal Deformity Surgery

Abstract ID: Poster 037

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BACKGROUND: Blood transfusions are associated with an increased risk of morbidity following surgery. The surgical magnitude of spinal deformity surgery may often result in multiple liters of blood loss. However, the incidence of, risk factors for, and short-term complications related to blood transfusions after adult deformity surgery have not been well described.

METHODS: A large, multi-center clinical registry was queried using CPT and ICD-9 codes to identify spine patients undergoing adult deformity surgery from 2010-2013. Patients undergoing a blood transfusion during surgery or within 3 days after surgery were identified with a database specific variable. Short-term, 30-day, peri-operative outcomes data on morbidity and mortality were analyzed and reported. Univariate and multivariate logistic regression analysis were used to identify patient characteristics, comorbidities, and operative variables predictive of blood transfusion. Statistical adjustment with propensity score matching was used to compare short-term outcomes between those receiving and not receiving a blood transfusion.

RESULTS: Overall, 2,194 of 17,425 patients received at least one blood transfusion (12.6%). Compared with patients not receiving blood, those with transfusion were more likely to experience any 30-day complication (16.8% vs. 6.5%, $p<0.001$), wound complications (3.7% vs. 1.9%, $p=0.001$), DVT (1.6% vs. 0.5%, $p<0.001$), PE (1.4% vs. 0.4%, $p<0.001$), unplanned intubation (1.1% vs. 0.3%, $p<0.001$), and reoperation (5.6% vs. 2.7%, $p<0.001$). When separated by procedure type, patients with instrumentation extending to the pelvis (69.3% vs. 30.7%) and an osteotomy (55.2% vs. 44.8%) were more likely to receive a blood transfusion ($p < 0.001$). Predictors of blood transfusion included advanced patient age > 80 years (OR 1.5, 95% CI: 1.11-1.95), BMI > 35 (OR 1.2, CI: 1.03-1.40), dyspnea (OR 1.3, CI: 1.07-1.63), Hematocrit < 36 (OR 2.5, CI: 2.18-2.95), patients with revision posterior surgery (OR 3.4, CI: 2.90-5.01), combined anterior/posterior surgery (OR 2.8, CI: 1.77-4.52), operative time > 4 hours (OR 3.8, CI: 3.37-4.36), and prolonged hospital length of stay > 4 days (OR 2.8, CI: 2.45-3.14).

CONCLUSIONS: Blood transfusion after adult spinal deformity surgery is fairly common at 12.5%. Blood transfusion was associated with more than twice the incidence 30-day complications, even after statistical adjustment. Surgeons should be aware of risk factors for transfusion and work towards minimizing blood loss during these large surgical procedures.

A Comparison of Patients Treated With Shilla Growing Rods for Early Onset Scoliosis

Abstract ID: Poster 038

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INTRODUCTION: The Shilla technique and implants were developed to manage early onset scoliosis and allow the child's spine to grow with as few return trips to the operating room as possible. The Shilla is a growth guidance system with limited fusion allowing continued vertebral growth in a corrected plane. This is a new technique for managing EOS and, therefore, has been refined since its initial implementation. We hypothesized that increased rod diameter would lead to fewer revisions and decreased implant failures.

METHODS: Retrospective chart review of the first 70 consecutive patients undergoing the Shilla technique were included. 12 patients did not meet inclusion criteria. Each patient was followed for at least 2 years noting time to revision and survival of the implants along with specific parameters from the index surgery. The series was divided into groups based on rod size; small (3.5/4.5) with 18 patients and large (4.5 or 5.5) with 40 patients. T-test and Kaplan Meier curves were used for analysis.

RESULTS: Comparing large vs. small rod sizes showed a significant difference in total number of returns to the OR at 2 years (p=.001); with decreased returns for patients with larger rods. There was no significance in revisions per month over the total time with the Shilla implants (p=0.40). Kaplan-Meier curve showed a trend of increased time to first return to the OR with larger rods. Implant failures as the cause for first return to the OR involved 11 patients in the small group and 14 in the large rod group. The small rod group included 5 with screw pull out (average 3.6 months) and 6 with rod fracture (14.5 months). The large rod group had 2 patients with screw pull out (3 months), 8 with rod fracture (44.875 months), and 4 that grew off of the implants (27.5 months). There was a significant difference in time to rod fracture (p=0.006) when comparing large vs. small rod groups.

CONCLUSION:
● Patients benefited with reduced returns to the OR by initial placement of larger diameter rods. Larger rods were more resistant to fracture and did not cause increased pull out of the screws.
● Screw pull out accounts for earlier returns to the OR than rod fracture which occurred later in the course of treatment (average 44.875 months in large rod group).

Safety and Efficacy of Liposomal Bupivicaine in Lumbar Spine Surgery

Abstract ID: Poster 039

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BACKGROUND: Local and regional anesthestic infiltration has been successfully used for postoperative analgesia in extremity surgery. No such equivalent blockade exists for patients undergoing lumbar spine surgery. However, the emergence of long-acting local anesthetic agents has shown utility in other areas of orthopedics. Reports of its use in knee arthroplasty have demonstrated efficacy close to that of regional blockade. This pilot study aims to determine the efficacy of liposomal bupivacaine (Exparel) in postoperative analgesia for patients undergoing lumbar spine surgery and report adverse outcomes or complications that may be specific to its use around the spine.

METHODS: The study was a retrospective review of lumbar procedures performed by a single surgeon in a university-based hospital setting. Exparel was used beginning in July 2014 to September 2014. 57 consecutive lumbar spine cases were performed with its administration and were matched to a cohort of 57 patients who underwent lumbar procedures in the period immediately preceding July ultimately beginning in April 2014. Patients with a history of adverse reactions to local anesthetics or under 19 were excluded. The drug was administered in the experimental group immediately prior to closure in the manufacturer recommended fashion into the subcutaneous wound bed and fascial margin. All wounds were closed in the same fashion with interrupted absorbable suture over a drain exiting through a separate skin incision. Demographic data and hospital length of stay (LOS) were recorded. Pain scores on a standard visual analogue scale (VAS) were recorded as an average over 8 hour shifts for 72 hours postoperatively and daily narcotic administration was collected and converted to oral morphine equivalents. A full neurological exam was performed daily.

RESULTS: Mean LOS and VAS scores for the first and third postoperative nursing shifts were less in the experimental group at 2.02 days, 4.43, and 3.83 vs. 2.83 days, 5.31, and 4.96 (p-values 0.17, 0.045, and 0.022, respectively). Mean narcotic use on the second postoperative day was also less in the experimental group with 61.3 mg vs. 79.9 mg approaching significance with p-value 0.051. One postoperative seroma was noted in the experimental group.

CONCLUSIONS: The use of liposomal bupivicaine shows promise as an adjuvant for postoperative analgesia in lumbar spine surgery with diminished pain scores in the first 24 hour postoperative period, trend towards less narcotic utilization, and little risk of complications. Further investigation with a larger prospective randomized study is warranted to better realize this effect.

The Effect of Smoking on Two-Level Anterior Cervical Discectomy and Fusion (ACDF): Preliminary Results

Abstract ID: Poster 040

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INTRODUCTION: Various factors influence graft fusion to local bone with ACDF procedures. Studies have demonstrated decreased fusion rates and greater changes in collapse with multi-level grafts in smoking patients. Knowing the effects of smoking on ACDF may help identify strategies that lead to better outcomes for smokers. Studying two-level ACDF may better identify risks and establish ways for deciding to perform ACDF. The objectives of our retrospective study were to assess effects of smoking on fusion rates for two-level ACDF patients and to assess the effect of smoking on patient-reported outcomes. This data may aid in the preoperative planning and decision to pursue ACDF.

METHODS: We collected data for adult patients who underwent a two-level ACDF at our institution between November 2011 and August 2014. Relationships between smoking status and age, fusion, Neck Disability Index (NDI), and postoperative outcomes were analyzed using unpaired t-tests and Fisher's test. Fusion was defined as when bony trabeculae were seen radiographically crossing the involved interspace at any point during follow-up. Delayed fusion was defined as failure of bone bridging the interspace and persistence of a linear lucency after 3-6 month follow-up radiograph; or, patients who only had 3 months follow-up and non-definitive radiographic evidence of fusion. Nonunion was defined as absence of radiographic evidence of fusion any time after 6-9 months follow-up or postoperative angulation collapse greater than 5°. Patient reported outcomes were captured with NDI.

RESULTS: Peri- and postoperative characteristics were reviewed for 35 patients who underwent two-level ACDF. Mean age of smokers (n=15) was 45.25 and non-smokers (n=20) was 52.38 (p=0.0177). Seven smokers (47%) and 8 (40%) non-smokers demonstrated evidence of solid fusion. Five (33%) smokers and 9 (45%) non-smokers showed delayed fusion (p=0.7104), and 3 (20%) smokers and 3 (15%) non-smokers demonstrated evidence of nonunion (p=1.000). At 3 months, smoking patients had a 6.8% reduction in NDI; non-smokers had a 15.7% reduction. At 6 months, smokers had a 10.2% reduction in NDI; non-smokers had an 18.5% reduction. One year postoperative NDI scores were reduced by 19.2% and 29.1% for smokers and non-smokers, respectively.

CONCLUSIONS: With these preliminary findings, we conclude smoking does not necessarily decrease the rate of radiographic evidence of fusion. However, smokers were less likely to have a decrease in NDI scores postoperatively, suggesting smoking may not decrease the likelihood of fusion in patients who smoke, but have poorer clinical outcomes.

TRAUMA

Device Sales Representatives in the Operating Room: Do We Really Need or Want Them? A Survey of Orthopedic Trauma Surgeons

Abstract ID: Poster 041

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PURPOSE: It is common to find device sales representatives (DSRs) in the operating room (OR) acting as an “unscrubbed” member of the surgical team. However, like drug salesmen, DSRs use their close interactions with surgeons to advance sales of their products. Despite this fact, little attention has been given to these relationships. The purposes of this study were to determine the current attitude of orthopedic trauma surgeons toward DSRs, especially regarding their presence in the operating room, and to establish the existence of any generational differences regarding surgeons’ attitudes toward these DSRs.

METHODS: A survey was created using a 5-point Likert response scale, related to conflict of interest (COI) and attitudes of orthopedic surgeons toward device manufacturer sales representatives. Participants were solicited by e-mail from the Orthopaedic Trauma Association (OTA) database of 384 active members. There were 127 (33%) completed surveys usable for analysis. Respondents were divided into two subcategories based on age (Baby Boomer vs. Gen X) for subsequent subgroup analysis. Descriptive statistics were used for the overall results. Perceived differences between the respondents and their peers regarding COI, as well as the subgroup analyses were evaluated using the appropriate statistical test with significance set as $p<0.05$.

RESULTS: Overall, respondents viewed their DSRs in a favorable light without any perception of COI. However, they all perceived their peers as being significantly different from themselves, being at greater risk for COI ($p<0.01$). Notably, the great majority reported having read the AAOS guidelines regarding the orthopedic surgeon's relationship with industry, but feel that most others have not. The vast majority of surgeons believe that they choose implants based on their device-specific merits and not due to contact with DSRs in the OR or from any services they provide. Furthermore, the respondents feel that DSRs have a place in the OR for most procedures, especially to provide needed assistance to the regular OR staff, with one notable generational difference. The majority of Gen X responders feel that DSRs should be in the OR for any and all cases, while Baby Boomers do not ($p<0.01$).

CONCLUSIONS: With one striking generational difference, most orthopedic trauma surgeons want and feel they need DSRs in the OR. Similar to the findings in other physician groups, they also feel they are not subject to COI from the salesman contact that affects their peers. The reasons for this perceived need and any related COI risk require further study.

Incidence and Sources of Sepsis Following Geriatric Hip Fracture Surgery

Abstract ID: Poster 042

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INTRODUCTION: Common sources for sepsis following hip fracture surgery include urinary tract infection (UTI), surgical site infection (SSI), and pneumonia. The purpose of this study is to characterize the incidence, sources, and clinical implications of sepsis following hip fracture surgery.

METHODS: Geriatric patients (≥65 years) undergoing surgery for proximal femoral fractures were identified in the 2005-2013 American College of Surgeons National Surgical Quality Improvement Program database. Among patients who developed sepsis, patients who concurrently were diagnosed with UTI, SSI, or pneumonia were identified. Multivariate regression was used to test for associations while adjusting for demographic, comorbidity, and procedural characteristics.

RESULTS: 19,344 patients were identified. Of these, 9,063 (46.9%) underwent hemiarthroplasty, 828 (4.3%) total joint arthroplasty, 567 (2.9%) percutaneous fixation, 2,963 (15.3%) plate/screw fixation, and 5,923 (30.6%) intramedullary fixation. 466 patients (2.4%) developed sepsis with a mortality rate that was significantly higher than patients who did not (21.0% vs. 3.8%, $p<0.001$). Among the 466 patients who developed sepsis, 157 (33.7%) also had UTI, 135 (29.0%) also had pneumonia, and 36 (7.7%) also had SSI. Of note, 37 patients (7.9%) had multiple infectious sources and 176 patients (37.8%) had no identifiable source. The rate of sepsis was elevated in patients who developed UTI (13.0% vs. 1.7%, $p<0.001$), pneumonia (18.2% vs. 1.8%, $p<0.001$), or SSI (14.8% vs. 2.3%, $p<0.001$). The rate of sepsis was elevated in patients with greater delays until surgery (0-1 days, 2.1%; 2-3 days, 3.0%; ≥4 days, 4.3%; $p<0.001$).

CONCLUSION: These findings suggest that the rate of sepsis following geriatric hip fracture surgery is about 1 in 40, and that the most common sources of sepsis are UTI and pneumonia. Patients who develop UTI, pneumonia, or SSI are at high risk for developing sepsis, and patients who develop sepsis are at high risk for mortality. Patients who sustain hip fractures should be screened and aggressively treated for UTI and pneumonia given the risk for subsequent sepsis and death.

Multi-Disciplinary Malnutrition Screening Program in Orthopedic Trauma Patients

Abstract ID: Poster 043

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INTRODUCTION: Postoperative complications in orthopedic trauma patients are contributing factors to the cost of healthcare and patient morbidity. A modifiable risk factor known to contribute to postoperative complications is malnutrition. However, there is little information about the results of a screening/treatment program for orthopedic trauma patients with malnutrition. The purpose of our study was to introduce a malnutrition screening and treatment protocol for orthopedic trauma patients to identify the incidence of malnutrition and determine appropriate screening techniques.

METHODS: Patients 18 or older indicated for operative fixation of acute fractures between August 1, 2014, and April 1, 2015, were enrolled in an IRB-approved prospective study to screen for malnutrition. Malnutrition screening consisted of serum albumin, transferrin, total lymphocyte count, and vitamin D. Additionally, patients were given a malnutrition screening questionnaire. The screening questionnaire identified high risk patients and initiated a formal evaluation by a board certified dietitian to confirm the diagnosis and give recommendations on diet supplementation.

RESULTS: 309 patients underwent operative treatment of orthopedic fractures over the study period. 280 patients (91%) had laboratory testing for albumin, 269 patients (87%) for transferrin, 198 patients (64%) for total lymphocyte count, 275 patients (89%) for Vitamin D, and 245 (79%) completed a nursing administered screening questionnaire. 141 patients (50%) had low albumin levels (<3.5 g/dL). 144 patients (54%) had low transferrin levels (<200 mg/dL). 48 patients (24%) had low total lymphocyte counts (<1000/mm^3). 155 patients (56%) had low vitamin D levels (<20 ng/mL). 65 patients (27%) were screened as high risk for malnutrition on the questionnaire and were evaluated by a dietitian. There were six wound-related complications within the screened group. One of these patients had decreased levels of albumin, transferrin, and vitamin D. Three patients developed deep surgical site infections requiring operative irrigation and debridement. Two of these patients had low vitamin D and albumin levels. There were three patients that had early hardware failure or nonunion with no evidence of infection. All of these patients had low vitamin D levels. The cost per patient of obtaining these laboratories was $624, for a total cost for all patients of $192,816.

CONCLUSION: Malnutrition is a common problem in orthopedic trauma patients. A cost effective program to identify at risk patients is needed. A screening questionnaire is easily administered and effective to identify high risk patients and combined with evaluation by a dietitian may supplant the need for costly laboratory studies.

Increased Fracture Angulation Results in Delayed Union After Nonoperative Management of Traumatic Humeral Shaft Fractures

Abstract ID: Poster 044

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INTRODUCTION: Humeral shaft fractures account for 3% of adult fractures and 20% of all humeral fractures. They are commonly caused by high-energy trauma in young males and low-energy falls in elderly females. While most humeral shaft fractures heal with non-operative management identifying patients who will have delayed union is of great interest. Our aim is to elucidate the predictors of delayed union after non-operative management of traumatic humeral shaft fractures.

METHODS: Records of 451 adult patients with humeral shaft fracture between 2005 and 2014 were reviewed and 85 patients who were treated non-operatively and had complete medical and imaging records with minimum of 6 weeks follow-up were retrospectively enrolled into the study. Delayed union was defined as a symptomatic limb with lack of radiographic healing at 6 weeks. The AO/OTA classification was used to classify fracture pattern by consensus among three trained examiners. Angulation of humeral shaft at the fracture site was measured on biplanar injury x-rays.

RESULTS: There were 85 humeral shaft fractures with mean follow-up of 6.2 months. Comorbidity was present in 45 patients (52.9%), and hypertension (35.3%) and diabetes (17.6%) were most prevalent. Large proportions of the cohort were smokers (42.4%) and abused alcohol (45.9%). Sixty-eight patients went on to union while 17 patients (20%) had delayed union and 11 patients (12.6%) eventually underwent operative fixation at median interval of 14 weeks (Range: 6–69 weeks). The mean angulation at the fracture site was 11.6° (95% confidence interval [CI]: 9.2-14.1) for patients with normal healing and 19.5° (95% CI: 11.2-27.8) for patients with delayed union (P=0.025). The mean fracture displacement (% cortical diameter) was 58.47% (95% CI: 50.1-66.9) for patients with normal healing and 72.6% (95% CI: 44.9-100.4) for patients with delayed union (P=0.32). Distribution of type A, B, and C fracture pattern was 39.7%, 17.6%, and 42.6% for patients with normal healing and 70.6%, 11.8%, and 17.6% for patients with delayed healing, respectively (P=0.068). Delayed fracture healing was higher among patients with chronic kidney (11.8% vs. 1.5%; P=0.04) and liver disease (23.5% vs. 5.9%; P 0.026).

CONCLUSION: Delayed union was observed in 20% of patients treated non-operatively and higher angulation at the fracture site, simple (type A) fractures patterns and history of chronic kidney and liver disease were associated with delayed healing and can be used in patient selection for operative fixation of humeral shaft fractures.

Does a Single Incision for Plating of the Tibia and Fibula in Pilon Fractures Have an Increased Complication Rate?

Abstract ID: Poster 045

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PURPOSE: High energy pilon fractures are often associated with a compromised soft tissue envelope. The anterolateral approach has been popularized as it permits adequate exposure of the tibia with full thickness flaps. The purpose of this study is to determine if a single incision (SI) for fixation of both the tibia and fibula has an increased complication rate compared to a dual incision (DI), through which the tibia and fibula are plated separately.

METHODS: A retrospective review of patients with pilon fractures who underwent plate fixation of both the tibia and fibula in a single setting at two level 1 trauma centers was performed. All patients with at least six months of follow-up were included. Demographic information, injury, and surgical details were recorded. Descriptive statistics were calculated for patient characteristics and outcome measures. Chi-square analysis was used to analyze nominal data. Logistic regression analysis was completed to compare the two methods of fixation in terms of outcome.

RESULTS: 53 patients met the eligibility criteria (33 males, 23 females), with an average age of 44 (range: 21-65). There were 7 OTA 43A; 6 43 B and 40 43 C type fractures. Motor vehicle collision and a fall from height were the two most common mechanisms of injury. 47 patients had an external fixator prior to definitive fixation. The patients had definitive surgery at an average of 13 days (range: 1-34) after initial injury. There were 22 patients with a SI and 31 underwent DI. The average follow-up was 14 months (range: 6-54). Complications included 1 wound dehiscence (SI); 5 wound complications requiring surgery (SI-4,DI -1); 5 nonunions (SI-2, DI-3); and 4 hardware failures (SI-3, DI-1). These results were not significant with all p values >0.05. In this cohort, age <30 was found to be a negative predictor of complication (p=0.045).

DISCUSSION: This is the first study to directly compare the complication rate in patients who underwent plate fixation of both the tibia and fibula in a single setting through either a single anterolateral approach or a dual incision. In our cohort, there was no difference in complication rate in patients with pilon fractures treated with a single anterolateral approach vs. a dual incision for plating of the tibia and fibula.

Trends in Total Elbow Arthroplasty for Distal Humerus Fractures in the United States, 2002-2011

Abstract ID: Poster 046

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INTRODUCTION: Operative management of distal humerus fractures often results in better patient satisfaction and improved functional outcomes in appropriately indicated patients. The purpose of this study is to describe recent national trends in the usage of total elbow arthroplasty (TEA) and open reduction and internal fixation (ORIF) for distal humerus fracture.

METHODS: The National Inpatient Sample (NIS) database from 2002 to 2011 was used to identify adult patients with a diagnosis of distal humerus fracture (ICD-9 codes: 812.4x-812.5x). Patients were then grouped by the surgical procedure that they underwent, either TEA (ICD-9 code: 81.84) or distal humerus ORIF (ICD-9 code: 79.31). The proportion of operative cases performed by TEA was plotted by year, along with age and sex subgroups, to examine current surgical trends. Associations of procedure type with demographic and clinical factors were assessed through univariate and multivariate analyses using survey-specific logistic regression. Hospitalization charges were also compared between the two groups.

RESULTS: The overall rate of TEA for the surgical management of distal humerus fractures was largely unchanged over the last decade. However, the rate of TEA has steadily risen for elderly females. The overall patient analysis showed that female sex, white race, and increasing age were independently associated with surgeon selection of TEA. While higher rates of pre-existing comorbidities were seen in TEA patients, this was not independently significant on multivariate analysis after adjusting for other confounding variables.

CONCLUSION: While there was a slight overall increase in the selection of TEA for distal humerus fractures in the first part of the last decade, this trend has leveled off in the most recent years studied. However, the use of TEA in the elderly female population continues to increase, coinciding with recent literature that has shown superior function with TEA in the elderly and osteoporotic patients. Across all years, older age, white race, and female sex were independently associated with increased TEA use. Given that this study also showed hospitalization charges were approximately $20,000 higher per TEA compared to distal humerus ORIF, utilization trends are important to analyze and understand.

Level of Evidence: Prognostic Level III

Intercostal Nerve Transfer to Restore Elbow Flexion

Abstract ID: Poster 047

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PURPOSE: The purpose of this study is to evaluate the outcomes of intercostal nerve transfer to the musculocutaneous motor branch for restoration of elbow flexion.

METHODS: Over a 10-year period, 85 patients underwent intercostal nerve transfers to the musculocutaneous nerve at a single institution. The average age at surgery was 30.5 years (17-65), mean BMI 29, with 11 females, and were 18 smokers. All patients had brachial plexus injuries with 19 having C5-C7 avulsions while most had C5-T1 avulsions (n=66). All (n=85) patients had grade 0 biceps strength preoperatively. Patients underwent intercostal nerve (ICN) transfer involving combinations of ICN 3-7 to the musculocutaneous nerve. Fifty-five (65%) patients underwent a simultaneous free gracilis muscle transfer to augment elbow flexion (n=24) or obtain wrist/finger flexion (n=31). Eleven patients had a pre-existing arterial (subclavian or axillary) injury.

RESULTS: At an average follow-up of 2.8 years (range, 1.0-9.2), 46 (54%) patients recovered at grade III or better elbow flexion strength. 69 (81%) patients demonstrated signs of muscle recovery on EMG at last follow-up. The mean elbow flexion was 88° (range, 0-150). The patients DASH scores improved from 48.5 preoperatively to 36.5 postoperatively ($p<0.001$), and VAS scores decreased from 5.9 (out of 10) to 4.8 postoperatively ($p=0.03$). The number (2, 3, or 4) intercostal nerves used did not have a significant impact on any of the final outcomes.

The use of a free muscle transfer improved postoperative elbow flexion strength, with 33 (total n=55, 60%) having greater than or equal to III muscle strength, compared to 12 (total n=30, 40%) of those without a free muscle transfer ($p=0.04$). There also were improvements in elbow range of motion (92 vs. 78) and EMG signs of recovery (85% vs. 70%), but these did not reach statistical significance. Free muscle transfer did significantly improve DASH scores (33 vs. 44, $p=0.03$). Patients with vascular injuries (n=11) had significantly worse rates of elbow flexion recovery, including worse muscle strengths ($p<0.01$), DASH scores ($p<0.01$), and rates of EMG recover ($p<0.03$). 45/75 (61%) of patients without vascular injurues obtained grade III elbow flexion or greater.

CONCLUSIONS: Intercostal nerve transfer in the setting of a complete or near complete brachial plexus injury leads to reasonable rates of recovery of elbow flexion. Pre-existing vascular injuries portend a poor outcome. In these patients with very limited options, intercostal nerve transfer represents a reasonable nerve transfer option.

VEGF-Mediated Angiogenesis and Vascularization of a PCLF Scaffold

Abstract ID: Poster 048

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HYPOTHESIS: Our goals were to: (1) create a biodegradable polymer scaffold compatible with surrounding tissues, (2) enable vascularization and tissue ingrowth, and via large pores, (3) assess the ability to facilitate collagen-based tissue and bone mineralization within the scaffold.

METHODS: We synthesized biodegradable polycaprolactone fumarate (PCLF) scaffolds to allow tissue ingrowth via large interconnected pores. Molds/scaffolds were printed on a 3D printer. The scaffolds were seeded with PLGA microspheres containing different groups of growth factors: (1) control, (2) VEGF alone, (3) VEGF+FGF-2, and (4) VEGF+BMP-2. Scaffolds were implanted into the subcutaneous tissues of rats for 6 and 12 weeks. The scaffolds were stained for: H&E, Gomori Trichrome (collagen ingrowth), Factor VIII (angiogenesis), von Kossa (mineral deposition), and M1/M2 immune staining (immune response against scaffolds). The scaffolds also underwent MicroCT angiography to examine vessel penetration and bone mineral deposition.

RESULTS: At the time of harvest, the scaffolds were found to be well incorporated into the surrounding tissues without any signs of an immune response against the material. MicroCT Angiography demonstrated marked tissue and vessel ingrowth throughout the pores traversing the body of the scaffolds. The scaffolds seeded with microspheres containing VEGF, as well as VEGF with BMP-2 or FGF-2 had significantly higher vascular ingrowth and vessel penetration than the control scaffolds ($p<0.01$). The scaffolds with BMP-2 (in addition to VEGF) had high levels of mineral deposition throughout the scaffold. Histologic analysis revealed significant tissue ingrowth throughout the pores in all groups containing VEGF, with more fatty infiltration in the control group. Augmenting the scaffolds with VEGF alone, or in combination with BMP-2 or FGF-2 led to marked collagen tissue infiltration throughout the pores (H&E, Gomori Trichrome), while those with BMP demonstrated mineral deposition into the pores. There was significant collagen infiltratiion (seen on H&E and Gomori Trichrome) in the VEGF and VEGF+FGF and VEGF+BMP, while VEGF+BMP had a large amount of mineral deposition (von Gossa). The scaffolds with VEGF were positive for Factor VIII, with vessels through the scaffolds.

SUMMARY POINTS: Our results show that the PCLF polymer scaffold can be utilized as a framework for vascular ingrowth and regeneration of multiple types of tissues. This novel scaffold and material has promise in tissue regeneration across all types of tissues, from soft tissue to bone.

SBRN vs. Sural Nerve Grafting; A Case-Control Analysis of 75 Patients

Abstract ID: Poster 049

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PURPOSE: The purpose of our study was to perform a case-control analysis of two sources of nerve graft; the denervated superficial branch of the radial nerve (SBRN) in patients with ipsilateral brachial plexus injuries and the normal sural nerve in nerve grafting to restore function in the upper extremity.

METHODS: Over a 10-year period, 25 patients underwent SBRN nerve grafting with a denervated ipsilateral nerve for brachial plexus injuries, which were T matched 2:1 with 50 patients who underwent sural nerve grafting by age, gender, and BMI.

RESULTS: The average follow-up for the use of ipsilateral denervated SBRN patients was 2.5 years (1-7) and for the sural patients was 2.8 years (1-9). In the denervated SBRN group, only 3 (12%) of patients experienced grade III or higher muscle function. All 3 of these patients underwent a grafting of the spinal accessory to triceps motor branch. This is in contrast to 20 (36%) of the patients who underwent sural nerve grafting achieving grade III or higher muscle recovery ($p<0.01$), including C5, C6, or upper trunk to axillary (n=5) and musculocutaneous (n=7); or spinal accessory to axillary (n=1), musculocutaneous (n=2), and triceps motor branch (n=5). Only 12% of the dennervated SBRN group had EMG signs of muscle recovery compared to 61% of the sural nerve group ($p<0.01$). Smoking had a negative impact on muscle recovery, decreasing the rate of grade III or higher recovery in the denervated SBRN group ($p<0.01$) and the sural group ($p=0.01$). No other factors had an impact on muscle recovery. Overall, patients in both groups had significant improvements in their preoperative to postoperative pain and DASH scores ($p<0.04$).

CONCLUSIONS: Use of ipsilateral denervated SBRN nerve grafts in patients with brachial plexus injuries has significantly poorer outcomes when compared to sural nerve grafts in the treatment of brachial plexus injuries in a matched series. The use of this denervated nerve should be saved for situations when no other nerves grafts are available and should be avoided when sural nerve grafts are available. Patients also should be counseled on the risks of smoking when choosing to undergo brachial plexus reconstruction.

FOOT AND ANKLE

Psychosocial Risk Factors of Postoperative Pain in Ankle and Hindfoot Reconstruction

Abstract ID: Poster 050

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INTRODUCTION: With the possibility of patient pain and satisfaction scores affecting reimbursement, there is increased awareness of pain as a complication. The purpose of this study was to examine medical, social, and psychological factors associated with pain after elective ankle and hindfoot reconstruction.

METHODS: 139 cases of total ankle replacement, ankle fusion, and/or hindfoot fusion over a 3-year period were identified. Retrospective chart review determined patient demographics, medical comorbidities, and associated surgical procedures. Specific preoperative factors including age, sex, body mass index, etiology, diabetes, tobacco use, alcohol use greater than two or more drinks per day, chronic pain disorder, mood disorder, and any preoperative narcotic use 3 months prior to surgery were examined. Narcotic usage was tracked through initial and subsequent postoperative prescriptions in the electronic medical record and linked narcotic database within a 2-year follow-up period. Primary outcomes were cumulative amount of narcotic prescribed (morphine milligram equivalent dose) in the initial 90-day postoperative period and need for continued narcotics beyond 90 days. Logistic and linear regression were used in statistical analysis. P-values less than 0.05 were considered significant.

RESULTS: The average amount of narcotic prescribed in the initial 90 days after surgery was 1711 mg (morphine equivalent) and 37% required narcotic prescriptions past 90 days. Preoperative narcotic use (76%; OR=7.67, 95% CI [2.36-24.91], $p<0.01$), chronic pain disorder (93%; OR=7.83, 95% CI [1.35-45.44], $p=0.02$), and mood disorder (77%; OR=10.67, 95% CI [3.46-32.83], $p<0.01$) were risk factors for continued narcotic use past 90 days in multivariate analysis. Tobacco use (4659 mg; $\beta=0.205$, $p=0.01$) and chronic pain disorder (5713 mg; $\beta=0.401$, $p<0.01$) were risk factors for increased initial postoperative narcotic use in a multivariate model. Age, sex, BMI, etiology, alcohol use, and diabetes were not associated with increased or continued postoperative narcotic use.

DISCUSSION AND CONCLUSION: Patients who were being treated for chronic pain preoperatively, had been diagnosed with a mood disorder, had been prescribed any amount of narcotics preoperatively, or used tobacco products had an increased risk for pain postoperatively. The presence of risk factors should prompt physicians to discuss modified pain management strategies before surgery.

Outcomes and Complications of Four Total Ankle Arthroplasty: STAR, SALTO, INBONE, and ZIMMER

Abstract ID: Poster 051

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BACKGROUND: Total ankle replacement using STAR implant was initially used followed by SALTO, INBONE, and ZIMMER implants. While four implants are currently used, there is a paucity of evidence in literatures to compare outcomes and complications.

MATERIAL AND METHODS: Retrospective review of 247 consecutive patients/258 ankles who underwent total ankle replacement using STAR (98 ankles), SALTO (121 ankles), INBONE (24 ankles), and Zimmer (15 ankles) implants between 1997 and 2015 (an average follow-up of 101.2, 52.3, 15.3, 13.7 months for STAR, SALTO, INBONE, ZIMMER). Primary outcome was VAS, FFI, SF-36, and secondary outcomes was 2-year, 5-year, and 10-year survival rate, ankle motion and complications. VAS, SF-36, and FFI was compared using one-way ANOVA. Independent t-test, Wilcoxon Rank Sum Test, and Chi-square test were used to compare other parameters and complications.

RESULTS: All four implants demonstrated significant improvement of functional outcomes and pain relief ($p<0.001$), but no significance between each pair of implants. Dorsiflexion was significantly improved in all groups ($p<0.05$). 2-year survival was 98.9%, 100%, 100%, 100% for STAR, SALTO, INBONE, Zimmer. 5-year survival was 91.7% and 96.2% and for STAR and SALTO but 10-year survival 86.1% for STAR. Short-term complication for STAR, SALTO, INBONE, ZIMMER implants was superficial infection (8.4%, 8.5%, 0%, 0%), deep infection (2.1%, 1.7%, 0%, 0%),medial malleolar fracture (6.3%, 6.8%, 0%, 0%), lateral malleolar fracture (0% ,2%, 0%, 0%), numbness (5.3%, 1.7%, 0%, 0%), stiffness (1.1%, 1.7%, 0%, 0%), gutter impingement 14.7%, .5%, 0%, 13.3%), talar subsidence (9.5%, 0.8%, 0%, 0%), tibia subsidence (4.2%, 3.4% ,0%, 0%), polyethylene fracture (6.3%, 0%, 0%, 0%), polyethylene wear (1.1%, 0.8%, 0%, 0%), and vascular injury (0%, 0.8%, 0%, 0%). SALTO had significant less talar component subsidence, gutter impingement, and polyethylene fracture than STAR ($p=0.005$, $p=0.002$, $p=0.007$), but no difference than other implants.

CONCLUSION: All implants demonstrated significant improvement in term of functional and clinical outcomes and pain relief as measured with FFI, SF-36, VAS, and ankle joint motion. The functional outcomes were comparable in all four types. Short-term complications were comparable in all groups, but long-term complications of INBONE and Zimmer implants required longer follow-up time. Further prospective clinical investigation is important.

Outcomes and Complications After Surgical Treatment of Flatfoot Deformity With Gastrocnemius Recession, Medial Calcaneal Slide Osteotomy, Lateral Column Lengthening, and Dorsal Opening Wedge of Medial Cuneiform

Abstract ID: Poster 052

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BACKGROUND: Surgical treatment of flatfoot deformity stage II includes gastrocnemius lengthening, soft tissue transfer, and bony procedure. However, some surgeons do not rely on the soft tissue transfer and they believe bony correction and gastrocnemius lengthening can improve outcomes, but there were limited study demonstrated outcomes and complication of gastrocnemius lengthening procedure and bony realignment procedure without tendon transfer.

MATERIALS AND METHODS: Retrospective chart review 113 consecutive patients/124 feet who underwent flatfoot reconstruction using either or combination of gastrocnemius lengthening with Cotton, medial calcaneal slide osteotomy, and EVAN; 13 patients (13 feet) with Cotton, 6 patients (6 feet) with EVAN, 17 patients (19 feet) with medial slide calcaneal osteotomy, 40 patients (46 feet) with EVAN and Cotton, 12 patients (12 feet) with medial calcaneal slide and Cotton, 3 patients (3 feet) medial calcaneal slide with EVAN, and 23 patients (24 feet) with medial calcaneal slide osteotomy, EVAN, and Cotton. Primary outcomes included FFI, SF-36, VAS, ankle dorsiflexion. Secondary outcomes included complications.

RESULTS: Bony correction with gastrocnemius lengthening demonstrated significant improvement in FFI, SF-36, VAS, and ankle dorsiflexion (all $p < 0.01$). An average of allograft length in the Cotton was 6.6 mm, EVAN was 7.4 mm. Mean improvement of AP talonavicular coverage was 14.5%, calcaneal pitch was 5.5°, lateral talocalcaneal angle was 2.6°, Meary angle was 16.9°, medial cuneiform-fifth metatarsal height was 7.3 mm, and Hindfoot alignment was 9.9 mm. Nonunion was shown in EVAN (3 of 79 feet, 3.8%) and no nonunion in Cotton and medial calcaneal slide osteotomy. Painful hardware was demonstrated in 21 of 124 feet (16.9%, 2 of 49 feet [4.1%] from Cotton, 10 of 79 feet [12.7%] from EVAN, and 9 of 46 feet [19.7%] from calcaneal osteotomy). Sural nerve injury was demonstrated in the calcaneal osteotomy 1 of 46 feet (2.2%) and 3 of 124 feet (2.4%) showed superficial wound complication.

CONCLUSION: Gastrocnemius lengthening and bony realignment procedure without tendon transfer procedures demonstrated significant improvement in terms of functional outcomes as measured with the FFI, SF-36, and VAS and improvement of alignment. This technique was feasible, safe, and effective for treatment of patients with flatfoot deformities.

Early Postoperative Functional Assessment Following Transtibial Amputation for Chronic Medical Conditions

Abstract ID: Poster 053

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BACKGROUND: Transtibial amputation serves as definitive treatment for a variety of maladies. Little research has been done to objectively quantify the activity level and quality of life of patients in the early postoperative period. This study utilized accelerometers and validated questionnaires to prospectively collect data on a series of consecutive patients having undergone transtibial amputation and fitting with an immediate postoperative prosthesis (pylon cast).

METHODS: 10 patients who met inclusion criteria were treated by a single surgeon and fitted with an immediate postoperative prosthesis between 2 and 4 days after their operation. There were 9 males and 1 female and reason for amputation was non-healing gangrenous ulcer in 9 patients and ischemic limb in 1 patient. Mean patient age was 58 (range 22–69) at the time of amputation. ActiGraph GT3X accelerometers were used to collect patient activity data for a period of 4-6 weeks postoperatively. An Amputee Mobility Predictor (AMP) clinician-rated performance evaluation was conducted at the six-weeks and an SF-36 form was utilized to obtain subjective quality of life information. Expected functional level was analyzed in conjunction with activity level and self-reported quality of life.

RESULTS: Patients in the cohort spent an average of 88% (range 83-92%) of their time sedentary, 11.5% (range 7.6-16.9%) of their time in light physical activity, and 0.3% (range 0.12-1.36%) of their time in moderate to vigorous physical activity. Compared to the published normative values of the SF-36, the cohort fell more than 1 SD below the societal mean in terms of mean physical functioning, emotional well-being, and social functioning. Utilizing the AMP clinical assessment tool, attempts were made to assess the relationship between expected level of function with actual activity status in the early postoperative period. No statistically significant relationship was observed.

CONCLUSIONS: Patients having undergone transtibial amputation for chronic medical conditions are extremely sedentary in the early postoperative period, have significant physical limitations, low emotional well-being, and poor social functioning. These facts seem to hold true irrespective of expected level of function. This study illustrates the potential importance of early physical rehabilitation in addition to emotional support for patients after transtibial amputation in order to optimize the likelihood of success after prosthetic fitting.

Minimally Invasive Intramedullary Screw Fixation of Distal Fibular Fractures

Abstract ID: Poster 054

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INTRODUCTION: Currently several ORIF methods include using plates, screws, intramedullary rods, tension bands, or K-wires have been used to treat a distal fibular fracture. However, there has been no report on using a minimally invasive cannulated intramedullary screw as a means of fixation for distal fibular fractures. This study found that using a minimally invasive cannulated intramedullary screw can serve as a treatment for distal fibular fractures with resulting high union rates, low complication rates, and equivalent clinical outcome as tradition fixation methods. This treatment protocol is especially useful in patients with high wound complication risks.

METHODS: In this retrospective study, 45 patients were identified who had a distal fibular fracture and undergone treatment with minimally invasive cannulated intramedullary screw fixation. All patients also had a soft tissue condition or comorbidity. The mean age was 54 years old. The Weber classification system was used to assess the type of fracture. The average time to union, the average time to weightbearing, and complications were some of the parameters that were looked at. The soft tissue conditions and comorbidities were also taken into account.

RESULTS: The average time to union was 10 weeks (range, 8 to 36 weeks), and the average time to weightbearing was 14 weeks (range, 8 to 40 weeks). There were two complications; one nonunion occurred and one patient had symptomatic hardware which resulted in hardware removal.

CONCLUSION: Using a minimally invasive cannulated intramedullary screw can serve as a treatment for distal fibular fractures with resulting high union rates, low complication rates, and equivalent clinical outcome as tradition fixation methods. This treatment protocol is especially useful in patients with high wound complication risks.

Keywords: distal fibular fracture, cannulated intramedullary screw, high risk wound complication

Treatment of Achilles Tendinopathy With Platelet Rich Plasma: A Prospective Cohort Study

Abstract ID: Poster 055

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INTRODUCTION: Platelet rich plasma (PRP) use in midsubstance and insertional Achilles tendinopathy lacks prospective evidence. Our study aimed to prospectively evaluate the response of midsubstance and insertional Achilles tendinopathy to PRP injection in patients who failed conservative treatment.

METHODS: 17 patients with midsubstance or insertional Achilles tendinopathy (1 bilateral) were prospectively enrolled for autologous PRP injection into the pathologic area of their Achilles tendon. Patients were followed for 1 year and evaluated at 0, 4, 8, 12, 24, and 52 weeks after injection using the Victoria Institute of Sport Assessment for Achilles tendinopathy (VISA-A) as the primary outcome measure. Secondary outcome measures included the 12-Item Short Form Survey (SF-12) and the visual analogue score (VAS).

RESULTS: 12 of 17 patients (13 of 18 injections) completed the 52-week follow-up. Mean VISA-A score improved significantly at 4 weeks from 27.3 to 42.2 ($p=0.007$) and continued to improve by 52 weeks with a mean score of 60.8 ($p<0.001$). The VAS improved from an initial score of 5.68 to 3.45 by 4 weeks ($p < 0.001$) and remained significantly improved at 52 weeks at 2.12 ($p < 0.001$). The SF-12 physical showed significant improvement at all time points compared to the initial time point, improving from 35.6 to 45.5 at 52 weeks ($p=0.002$). No complications were reported. 3 patients underwent re-injection, 2 at 9 months and 1 at 18 months. Two of the 5 patients not completing 52 weeks of follow-up elected to undergo surgery, and 3 were lost to follow-up.

DISCUSSION AND CONCLUSION: Treatment of midsubstance and insertional Achilles tendinopathy with PRP injection is a reasonable and relatively safe minimally invasive treatment option prior to the decision for surgery in patient’s refractory to conservative management.

Closed Reduction Percutaneous Fixation vs. Open Reduction Internal Fixation of Intra-Articular Calcaneal Fractures

Abstract ID: Poster 057

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PURPOSE: Both percutaneous fixation and open reduction internal fixation are used for the surgical treatment of intra-articular calcaneal fractures. However, there is no general consensus as to which method is preferred. There has been an association with increased risk of wound complications when treating these fractures with open techniques, such as wound dehiscence and deep infections. Percutaneous techniques allow the surgeon to restore calcaneal anatomy in a minimally invasive fashion, therefore avoiding wound complications especially in the context of extensive soft tissue damage.

Our hypothesis is that the group treated by percutaneous fixation will have similar outcomes in addition to decreased incidence of wound complications.

METHODS: We generated a list of patients who were treated surgically for a calcaneus fracture at a level 1 trauma center by the senior author from July 2003 through March 2013. Patients were then divided into 2 groups based on surgical treatment received: (1) group 1 consists of patients treated by closed reduction and percutaneous fixation (CRPP); (2) group 2 consists of patients treated by open reduction internal fixation (ORIF). Data analysis for each group included demographics, fracture classification, open vs. closed fractures, complications, and re-operations.

We included all adult patients treated over the course of 10 years (2003–2013) by CRPP or ORIF at a single level 1 trauma center by a single orthopedic surgeon (fellowship trained in foot and ankle) with at least 1 month follow-up. We excluded pediatric patients. Patients with less than 1 month of follow-up were also excluded.

RESULTS: There were a total of 57 patients who met the inclusion criteria. 32 patients underwent CRPP (average follow-up 22.17 months) and 25 patients underwent ORIF (average follow-up 17.5 months). 7 patients from the ORIF group developed a postoperative wound complication (all 7 required a reoperation for an irrigation and debridement) compared to only 1 patient from the CRPP group (also required an irrigation and debridement). This difference was statistically significant ($p=0.0073$). 8 patients in CRPP group developed symptomatic subtalar arthritis requiring intervention (cortisone injection or subtalar fusion) compared to 5 patients in ORIF group (p value $= 0.655$).

CONCLUSION: Both procedures may be considered for the surgical treatment of intra-articular calcaneal fractures; however, it appears that closed reduction percutaneous fixation leads to less postoperative wound complications while also having a similar incidence of post-traumatic subtalar joint arthritis.

SPORTS

The Effects of Medial Compartment Distraction on ACL Strain

Abstract ID: Poster 058

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PURPOSE: The objective of this study was to determine what effect medial compartment distraction has on ACL strain.

METHODS: A Differential Variable Reluctance Transducer (DVRT) was attached to the anteriomedial bundle of the ACL to measure strain in eight human cadaveric knees.

Each knee was tested at 0° and 30° with the MCL intact. The strain on the ACL was measured while the medial compartment was gapped starting at 0.5 mm increments from 1 mm up to maximum gapping. This was repeated with the MCL deficient and the MCL reconstructed. The data was compared by repeated measures ANOVA ($p<0.05$).

The MCL was reconstructed using semitendonous and gracilis tendon grafts. The tendons were left on their tibial insertion and looped around a spiked washer at the medial femoral epicondyle. The remaining graft was attached to the MCL insertion site with a staple. The graft was tensioned at 30° of flexion.

RESULTS: At full extension, the transected MCL group had a maximum ACL strain that was significantly higher than the intact and reconstructed group ($p=0.012$). The intact and reconstructed groups maximum strain were not significantly different at full extension ($p=0.225$) or 30° flexion ($p= 0.225$).

At full extension, when comparing ACL strain in the intact group at maximal distraction (average 4.19 mm) to the transected group at each interval of medial compartment distraction, there became a significant increase in ACL strain at 5.5 mm of total medial compartment distraction ($p=0.012$). This was significantly higher for each subsequent increase in distraction.

At 30° flexion, the transected group first showed significant increase in ACL strain at 9.5 mm of distraction compared to the maximal ACL strain of the intact group (4.44 mm) ($p=0.036$). However, there was a trend beginning at 6.5 mm of distraction in the transected group ($p=0.05$).

CONCLUSION: Combined ACL/MCL injuries in which the MCL injury is untreated and/or heals in an elongated position may put ACL reconstructions at higher risk for failure. These results demonstrate a significant increase in ACL strain when the medial compartment is distracted as little as 1.3 mm greater than the baseline maximal distraction the intact knee allows while in full extension. At 30° of flexion, a significant increase in ACL strain is observed at 2.1 mm of distraction above what the intact knee will allow.

This study also showed that the reconstruction we have described can return a MCL deficient knee to intact knee biomechanics.

Repeat Meniscus Repair: What Result Can We Expect?

Abstract ID: Poster 059

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BACKGROUND: Currently, there is little evidence to guide management of a recurrent tear after meniscal repair. The purpose of this study was to (1) report outcome for patients who underwent repeat meniscal repair, and (2) evaluate injury and surgery-related factors predictive of outcome.

METHODS: A search of the medical record at a single institution found 29 patients who received repeat meniscal repair between 1997 and 2012. Tears were characterized by zone and pattern. Red-red zone was defined as less than 3 mm from the meniscosynovial junction, and red-white zone as between 3-5 mm. Tear patterns were classified as simple (a single plane tear), bucket handle (a displaced fragment attached anteriorly and posteriorly), or complex (a multi-plane tear). Surgical technique was defined as all inside, inside-out, or hybrid technique. Failure was defined as continued pain, catching or locking, and/or subsequent meniscal procedure. Clinical and functional outcome was evaluated by International Knee Documentation Committee and Tegner subjective outcome scores. Tear zone, tear pattern, patient age, surgical technique, and combined ligamentous repair were evaluated as predictors of failure.

RESULTS: Twenty-nine patients, 22 (76%) males and 7 (24%) females, underwent repeat meniscal repair at an average age of 22.0 years (range, 14-38). Eleven (38%) lateral menisci and 18 (62%) medial menisci were repaired at mean 28 months (range, 2-82) after primary surgery for 8 (28%) simple, 7 (24%) bucket-handle, and 14 (48%) complex tear patterns. Nineteen tears (65%) occurred in the red-red zone, and 10 (35%) in the red-white zone. Combined ligamentous surgery occurred in 13 (44%) patients with 9 (31%) ACL reconstructions, 1 (3%) PCL reconstruction, 2 (7%) ACL reconstructions/MCL repairs, and 1 (3%) ACL/PCL/MCL reconstruction/repair. Within 3 years of repeat surgery, 7 (24%) cases had documented re-retear, and 5 (17%) patients underwent subsequent meniscectomy. At five-year follow-up, 9 (45%) patients met criteria for failure. For patients with an intact repair, mean Tegner and International Knee Documentation Committee scores were 6.4 (range, 3-8) and 82.8 (range, 67.8-96.6), respectively. Tear zone ($p=0.71$), tear pattern ($p=0.11$), surgical technique ($p=0.17$), and combined ligamentous repair ($p=0.96$) were not significant predictors of failure; however, patients with a successful repair were significantly older than patients that failed repeat meniscal repair ($p=0.02$).

DISCUSSION: In this study, outcomes were modest with an overall failure rate of 45%. However, repeat meniscal repair should be considered in select cases. Younger patients may be at even higher risk for repair failure.

Arthroscopic Treatments for Degenerative Knee Cartilage Conditions Are Decreasing in the United States

Abstract ID: Poster 060

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INTRODUCTION: Several recent studies have demonstrated limited to no benefit of arthroscopy for degenerative cartilage conditions in the knee. In response, the AAOS released its first set of CPGs for knee arthroscopy in 2008, and changes to coding and reimbursement were implemented in 2012. The purpose of this study was to evaluate the influence of these factors on the volume of arthroscopic articular cartilage surgery for degenerative knee conditions.

METHODS: The Humana Inc. administrative claims dataset was reviewed from 2007-2014 for all patients undergoing arthroscopic chondroplasty and microfracture procedures. The insurance dataset covers 16 million patients and includes private/commercial and Medicare/Medicare Advantage plans. Patients were identified using CPT codes for chondroplasty and microfracture. The data was analyzed categorically according to patient age (<50 vs. >50 years) and diagnosis of osteoarthritis (by ICD-9 coding) prior to knee arthroscopy. Trends in procedure volume were assessed over time.

RESULTS: There were 17,946 patients that underwent chondroplasty and 10,087 that underwent microfracture during the study period. Chondroplasty volume declined significantly (by 69.5%) from 3072 cases in 2007 to 937 cases in 2014, with the sharpest area of decline occurring between 2011 and 2012. Chondroplasty volume declined by 69.5% between 2007 and 2014 with similar changes in populations older and younger than 50. There was a 54.7% decrease in chondroplasty volume in patients diagnosed with osteoarthritis. Microfracture volume has remained steady overall (1154 cases in 2007 and 1188 cases in 2014); however, in patients with a diagnosis of osteoarthritis, microfracture volume increased by 52.2%.

CONCLUSIONS: Overall, knee arthroscopy for degenerative knee conditions has significantly declined since 2007. The influence of the AAOS's CPGs and administrative coding practices correlates well with these changes. The increasing volume of microfracture procedures in patients with osteoarthritis warrants further study.

Long-Term Outcomes of Articular Cartilage Surgery: A Systematic Review

Abstract ID: Poster 061

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BACKGROUND: Currently, there is good evidence that cartilage restoration techniques are effective in improving knee function at short-term follow-up. However, there is currently a paucity of data reporting the durability of these procedures. Therefore, the purpose of this systematic review was to evaluate (1) activity level, (2) knee function, (3) re-operation, and (4) failure rates of cartilage restoration techniques at long-term follow-up.

METHODS: A comprehensive review of the literature was performed with specific inclusion criteria for studies with long-term outcomes after autologous chondrocyte implantation (ACI), microfracture (MFX), osteochondral allografts (OCA), and osteochondral autograft transfer (OAT). Studies included reported on activity-based outcomes including the Tegner Activity Scale, Lysholm score, and International Knee Documentation Society subjective score (IKDC). Reoperation and failure rates, as determined by the publishing authors, were recorded for each study.

RESULTS: Twenty-three studies with a mean follow-up time of 11.8 years (range, 8 to 21.8 years) met inclusion criteria. This included 1425 patients (60% male, 40% female) with an average age of 32.1 year at final follow-up. There was significant variability in outcomes assessment and definition of failure. Tegner scores were superior in patients treated with OAT and MFX compared to ACI ($p<0.01$). Lysholm scores were superior in patients treated with ACI and OAT compared to MFX (Figure 1; $p<0.01$). Overall, average IKDC scores improved from 42.3 at baseline to 71.4 at long-term follow-up in all groups ($p<0.01$), with no significant differences between the techniques. OCA procedures reported the highest reoperation rate at 39% followed by OAT (28%), MFX (17%), and ACI (16%) (Figure 2; $p<0.01$). However, the majority of reoperations in OCA (61%) were not related to the cartilage restoration technique. Both ACI and MFX (16% and 13%) reported lower failure rates than OAT and OCA (24% and 28%) ($p<0.01$).

CONCLUSIONS: Overall, cartilage restoration surgery was successful in 80% of patients at long-term follow-up, but had a reoperation rate of 25%. OAT showed superior results in functional outcomes and return to activity, while ACI and MFX demonstrated the lowest failure rates. Nonetheless, this systematic review is limited by heterogeneity in surgical technique, reporting of non-standardized outcome measures, lesion size, bone involvement, and patient characteristics.

Click here to view Figure 1

Click here to view Figure 2

Can ACL Reaming Method be Determined from Plain X-Rays?

Abstract ID: Poster 062

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INTRODUCTION: Incorrect tunnel placement is cited as one of the most common reasons for failure after ACL Reconstruction (ACL-R). Reaming the femoral tunnel through an anteromedial portal (AM) vs. reaming it transtibially (TT) has been advocated as one way to improve positioning of the femoral tunnel. Often times judgments about tunnel placements and reaming method are made from plain radiographs (XRs) alone. We hypothesized that reaming method cannot be determined from plain radiographs alone, and that perception of femoral tunnel placement on XRs influences assumption of reaming method.

METHODS: This study was IRB approved. We retrospectively reviewed the operative reports of primary ACL-Rs from the senior author from 2006-2010 during which time the senior author was transitioning from the TT to the AM reaming method. Forty total cases, including 20 cases of TT reaming and 20 matched cases of AM reaming were chosen for inclusion in this study. Reviewers were blinded to actual reaming method and asked to assess femoral tunnel placement and guess at reaming method for each patient. Kappa values were calculated for individual reviewers as well as groups of reviewers (attendings, fellows, residents). Using a Pearson correlation, we assessed the relationship between the TT error rate and negative judgments about the femoral tunnel (FT) placement in the AP and lateral projections. The TT error rate was defined as the probability of erroneously assessing the reaming method as TT, rather than AM. Meanwhile, negative FT placements were defined as judging the FT placement as incorrect.

RESULTS: The average kappa value among all 14 reviewers was 0.26 (range -0.08 to 0.70, SEM ± 0.06). Amount of agreement ranged from no to slight (six), fair (four), moderate (two), and substantial (two) agreement. There was no significant difference between Kappa values among reviewer classification (attending, fellow, or resident). Pearson correlations indicated that TT error rate positively correlated with negative FT judgments in the AP views, $r=0.648$, $p=0.012$. Importantly, this correlation was unique to TT error rate and there was no parallel correlation between AM error rate and negative FT judgments, $r= -0.005$, $p=0.987$.

DISCUSSION AND CONCLUSION: Most orthopedic surgeons, fellows, and residents were not able to reliably determine which ACL-R reaming method was used based on plain radiographs alone. In addition, reviewers exhibited a bias toward incorrectly guessing reaming method as being TT if they judged the placement of the femoral tunnel to be incorrect on AP radiographic views.

Fastball Pitch Velocity Predicts Ulnar Collateral Ligament Reconstruction Major League Baseball Pitchers

Abstract ID: Poster 063

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SUMMARY: This multivariate retrospective analysis demonstrates that peak fastball pitch velocity is the best predictor for ulnar collateral ligament reconstruction in Major League Baseball Pitchers.

INTRODUCTION: UCL injury and surgical reconstruction remain one of most common issues among major league baseball players. The purpose of this study was to determine UCLR-specific predictors among MLB pitchers. We hypothesized that UCLR pitchers would have higher pre-injury velocity based upon recent results in youth pitchers.

METHODS: Pitch velocity, number, and type for every pitcher and game within the MLB from April 2, 2007, until April 14, 2015, was gathered from the publicly available PitchFx database. Data from after 2012 was excluded to avoid lead-time bias. Using publicly available information, the names and approximate dates of surgery for every MLB pitcher ever to undergo UCLR were collected, including those prior to 2007 and after 2012. Each pitcher-game was then classified as “control”, “pre-injury”, or “postoperative”. “Control and “pre-injury” pitchers were then compared to determine risk factors for UCLR.

RESULTS: In summary, 1,327 pitchers were included, of whom 309 (26.8%) had undergone UCLR. 145 had pre-injury velocity data, and 208 had postoperative velocity data. Peak pitch velocity was significantly higher among pre-injury pitchers than control pitchers (mean [95% confidence intervals] 93.3 [92.8, 93.8] mph vs. 92.1 [91.9, 92.3] mph, $p<0.001$) as was mean pitch velocity (87.8 [87.3, 88.3] mph vs. 86.9 [86.7, 87.1] mph, $p=0.001$). Both demonstrated a dose-response relationship (Figure 1). Postoperative UCLR pitchers had significantly lower peak pitch velocity than pre-injury players ($p<0.001$), but did not differ from controls ($p=0.051$). While height did not differ ($p=0.934$), weight was significantly higher for pre-injury pitchers than controls (98.2 [96.7, 99.6] vs. 96.1 [95.5, 96.7] kg, $p=0.005$). Pitch counts per year were significantly lower for pre-injury pitchers than control pitchers although pre-injury pitchers threw more breaking pitches (Total pitches 589 vs. 673 $p=0.002$, Fastballs 377 vs. 418 $p=0.001$, Breaking pitches 53 vs.418 $p=0.003$). On multivariate regression peak pitch velocity was the primary independent predictor of whether a pitcher underwent UCLR ($p<0.001$) with mean velocity ($p=0.013$), body mass ($p=0.01$), and age ($p=0.006$) being secondary predictors. Pitch counts were not significant predictors.

CONCLUSION: Among MLB pitchers, higher pitch velocity, higher weight, and younger age are significant predictive factors of subsequent risk for UCL reconstruction. Within MLB pitchers, after velocity is accounted for, competition pitch counts do not predict subsequent UCLR.

HAND

Outcomes of a Cementless Thumb Basal Joint Hemiarthroplasty for Treatment of Trapeziometacarpal Osteoarthritis

Abstract ID: Poster 064

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INTRODUCTION: Multiple surgical procedures and implants have been developed to treat trapeziometacarpal joint osteoarthritis. Recently, a promising thumb basal joint hemiarthroplasty was reported in the literature to provide pain relief and improved function. In the aforementioned study, the authors reported a 94% implant survivorship with revision as an endpoint at a mean follow-up of 72.1 months. The purpose of our study was to evaluate the senior author's clinical results and survivorship of thumb basal joint hemiarthroplasty using the same device.

METHODS: We performed 35 basal joint hemiarthroplasties in 32 patients from 2011 to 2014. Of these, 26 thumbs (25 patients) had clinical follow-up of at least 12 months. Mean age of the patients was 54 years (range 43-68 years) with 88% females. All patients had Eaton-Littler Stage II or III arthritis preoperatively. Average follow-up was 17.2 months (range 12-26 months). The main outcomes were revision rate and time to revision. Pre- and postoperative radiographs were examined to determine the amount of overall thumb ray lengthening and amount of subsidence of the implant between those revised and unrevised. Student's t-test and Fisher exact test was used for statistical analysis ($p<0.05$).

RESULTS: At final follow-up, 13 of 26 thumbs (50%) had been revised with implant removal, resection of remaining trapezium, and ligament reconstruction with tendon interposition (LRTI). Another 3 thumbs were symptomatic and planning on future revision. Continued pain and implant subsidence through trapezium was the clinical reason for revision. Mean time to revision was 13.8 months (range 8-23 months). Those needing revision were younger (52 vs. 57 years $p< 0.03$) and had index procedure more often on the dominant side (46% vs. 31%). There was no significant difference between those revised and unrevised in terms of percentage of thumb ray lengthening (8% vs. 9%, $p=0.486$) and amount of trapezial subsidence (2.8 mm vs. 2.2 mm, $p=0.202$). Kaplan-Meier analysis with revision as the endpoint showed 61% survivorship at mean follow-up of 17.2 months.

CONCLUSIONS: Although a limited number of cases were examined, we found poor implant survivorship and an unacceptably high rate of reoperation with the BioPro thumb basal joint hemiarthroplasty device. These results are in stark contrast to previous reports in the literature. Therefore,we can not advocate for continued use of the device and no longer use this implant for thumb basal joint arthroplasty.

Increased Rotation Instability in Ulnar Collateral Ligament Injuries of the Thumb: A Biomechanical Study

Abstract ID: Poster 065

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INTRODUCTION: Injuries to the ulnar collateral ligament alter the mechanics of the thumb metacarpal phalangeal (MCP) joint. In a normal thumb, there is minimal rotation about the MCP joint, but with a complete injury to the medial ligamentous structures a clinically increased rotation about the MCP joint can be detected. The purpose of our study is to substantiate our clinical finding in a cadaveric model. Our hypothesis was that sequentially disrupting the dorsal capsule, the proper ulnar collateral ligament (pUCL) and the accessory ulnar collateral ligament (aUCL) of a thumb will lead to significant progressive rotational instability.

MATERIALS AND METHODS: Twelve fresh from adult cadaveric upper extremities with intact thumbs and no prior history of thumb injury were used for this study. The mean age was 65 (range 49-76) with 4 females and 8 males specimens. The specimens were thawed to room temperature and dissected to expose the dorsal capsule, the pUCL, and the aUCL. With fluoroscopic assistance, two 0.45 Kirshner wires were placed through the distal metacarpal and proximal phalanx approximately 2 cm from the MCP joint. These wires were placed parallel to joint line and parallel to the horizon. The dorsal capsule, pUCL, and aUCL were sequentially sectioned and the MCP joint was ranged manually in pronation and supination in the natural resting position of the hand. This reproduces the rotational examination which can easily be done clinically. Digital photographs captured the extremes of motion (pronation and supination) at baseline and after each structure were sectioned. A digital goniometer was used to measure the relative pronation and supination between the proximal phalanx and the metacarpal using the k-wires to mark rotation. A student's paired t-test was used for statistical analysis with a threshold of $p<0.05$.

RESULTS: Mean baseline pronation and supination were 16° (SD±4.3°) and 12.8° (SD±4.2°), respectively. After sectioning the dorsal capsule and pUCL, the mean pronation and supination were 23.4° (SD±8.8°) and 21.6° (SD±3.4°), respectively and increased to 28.2° (SD±9.2°) and 29.7° (SD±2.6°) in pronation and supination, respectively, after sectioning the aUCL. These were both significant changes from baseline ($p<0.05$). With the pUCL sectioned, there was a mean increase in percent pronation and supination of 29.2% (SD±14.8%) and 39.2% (SD±22.4%), respectively compared to baseline. With the aUCL also sectioned, the increase in percent pronation and supination from baseline was 41.6% (SD±12.8%) and 57% (SD±12.9%), respectively.

CONCLUSIONS: This biomechanical study demonstrates a significant increase in the rotational instability (pronation and supination) of the metacarpal phalangeal joint after UCL injury. The findings highlight the important contribution of rotational instability alone in this injury. Clinically, this increase in rotational instability can help more accurately diagnose gamekeeper's thumb and supplement traditional valgus stress testing of this injury.

Implant Analysis in the Treatment of Proximal Interphalangeal Joint Osteoarthritis; Silicone, Pyrocarbon, and SRA

Abstract ID: Poster 066

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HYPOTHESIS: Despite the increasing prevalence osteoarthritis (OA), the surgical treatment options for proximal interphalangeal (PIP) joint OA remain arthroplasty and arthrodesis. The purpose of this investigation was to evaluate the results PIP arthroplasty in patients with OA, comparing the outcomes of 3 different implants examining survivorship, patient-related factors, and clinical outcomes.

METHODS: We performed a review of 169 primary PIP arthroplasties by 8 surgeons in 103 patients for osteoarthritis at our institution from 1998 to 2012. The mean age at surgery was 65 years, BMI 26, with 51% involving the dominant extremity, 84% females, 5% smokers, 2% laborers, and 6% with diabetes mellitus (DM). Implants utilized included 108 pyrocarbon, 53 surface replacing arthroplasties (SRA), and 8 silicone. Patient characteristics were similar between the pyrocarbon, SRA, and silicone groups: age (65, 65, 66), females (84%, 83%, 88%), and DM (4%, 8%, 25%), respectively.

RESULTS: There were 26 revision surgeries performed at a mean 1.3 years postoperatively. The 2-, 5-, and 10-year survival rates were 88%, 82%, and 80%, respectively. The 5-year survival rates for the pyrocarbon, SRA, and silicone implants were 85%, 77%, and 88% ($p=0.69$), respectively. There were 8 intraoperative fractures that complicated the primary arthroplasty. Postoperatively, there were 2 periprosthetic fractures, 4 dislocations, 10 heterotopic ossification, and 7 infections. Silicone implants were associated with an increased infection rate ($p=0.03$). In those unrevised patients, at a mean 5.3 years (2-11) follow-up, pain levels improved from preoperatively to postoperatively ($p<0.01$). PIP total arc of motion did not significantly change from preoperatively (47°) to postoperatively (44°) ($p=0.67$). There also was no significant change in grip ($p=0.34$) or pinch strength ($p=0.32$). There were no significant differences according to implant type regarding pain ($p=0.44$), as well as grip or pinch strength ($p>0.21$). The total arc of PIP motion in the pyrocarbon, SRA, and silicone groups was 42°, 57°, and 42° ($p=0.29$), respectively.

SUMMARY POINTS: Arthroplasty in the treatment of osteoarthritis with PIP provides predictable pain relief, with preservation of PIP motion, and reasonable medium-term implant survival. There were no differences between 3 different types of implants with regards to survival, complications, pain relief, or PIP motion.

Reduction-Association of the Scapholunate: A Functional and Radiological Outcome Study

Abstract ID: Poster 067

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INTRODUCTION: Scapholunate dissociations being the most common type of carpal instability are challenging problems to address. Irreparable tears are common causes of mechanical wrist pain and many times the soft-tissue procedures are not able to reliably restore and preserve normal carpal alignment. The reduction-association of scapholunate (RASL) procedure to address patients without arthritis has been described previously with variable results. Thus, we sought to review the long-term outcome of patients undergoing RASL procedure to address chronic non-repairable scapholunate dissociation in our institution.

METHODS: A retrospective review of 12 patients undergoing RASL with an average of 24.1 months follow up (4-43 months) was performed. The visual analogue score (VAS), wrist range of motion, grip and pinch strength, postoperative complications, and radiographic parameters were recorded.

RESULTS: All patients had Geissler stage III (2 patients; 16.7%) or stage IV (10 patients; 83.3%). The postoperative VAS scores improved from 6.2 to 3.6. The grip and pinch strength decreased by 82.2% and 56.5%, respectively. The scapholunate (SL) interval at final follow-up had decreased from 4.5 ± 2.1 mm to 2.67 ± 1.37 mm ($p=0.007$). The SL angle was stable at final radiographic follow-up, measuring 51.5 ± 13.9 at final follow-up. Flexion and extension had decreased from 63.28º ± 12.92º and 61.5º ± 14.2º to 41.4º ± 20.46º and 52.8º ± 17.3º, respectively ($p<0.05$). The mean postoperative Disability of the Arm, Shoulder, and Hand (DASH) score was 15.3 ± 11.1. All patients other than two had planned removal of their screws at average of 18.5 months (range, 2.4-43.2 months). Seven patients (58.3%) developed wrist arthritis (five SLAC stage II and three SLAC stage III). Two underwent partial wrist fusion. Age, sex, preoperative SL interval, SL angle, Geissler classification, preoperative range of motion or strengths did not affect the final outcomes.

DISCUSSION: RASL can substantially decrease the scapholunate diastasis; however, it was not able to provide stability of the SL interval with many requiring secondary procedures for screw removal secondary to loosening, or partial wrist fusions. Majority of patients developed scapholunate advance collapse at final follow-up. Future long-term studies are recommended to assess and compare RASL to soft tissue reconstruction procedures to address chronic scapholunate instabilities.

Mini Tightrope Fixation vs. Ligament Reconstruction-Tendon Interposition for Maintenance of Post-Trapeziectomy Space Height: A Biomechanical Study

Abstract ID: Poster 068

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INTRODUCTION: Subsidence of the thumb metacarpal after trapeziectomy may lead to loss of first metacarpal height, resulting in weakness of pinch strength and symptomatic impingement of the metacarpal on the scaphoid. Suspension procedures including ligament reconstruction-tendon interposition (LRTI) and mini-TightRope fixation have been described to prevent metacarpal subsidence. The purpose of this study is to test the biomechanical stability of LRTI compared to single and double mini-Tightrope fixation after trapeziectomy.

METHOD: Fifteen, fresh human cadaveric hands underwent trapeziectomy through a dorsal approach. The specimens were then split into three groups with five undergoing LRTI with a Bio-Tenodesis Screw System fixation, five undergoing single mini-TightRope fixation, and five undergoing dual mini-TightRope fixation. The first and second digits were removed distal to the metacarpal. The distal ends of the exposed metacarpals and proximal radius were potted in urethane resin and mounted to a servohydraulic testing machine. A cyclic axial load was applied to the trapezium cavity. Displacement of the first metacarpal was recorded via the position of the actuator head and the size of the trapezial space was computed as the difference of the initial size and first metacarpal displacement. Each specimen underwent cyclical loading until the first metacarpal had collapsed completely onto the scaphoid (failure of the repair) or six hours of testing had been completed. The number of cycles to failure, change in the size of the trapezium cavity, and relative change in size of the trapezium cavity were determined.

RESULTS: The trapezial space was completely obliterated prior to the completion of the six hours of testing in all LRTI specimens (mean cycles to failure of 14,063±13,931) and remained present in all single and dual mini-TightRope specimens. The absolute (and normalized) changes in the size of the trapezial cavity in the single mini-TightRope and dual mini-TightRope were 11.4±1.7 mm (63.5±8.8%) and 9.9±1.6 mm (50.8±5.5%), respectively. Differences between the normalized gap changes in the LRTI and single mini-TightRope and LRTI and dual mini-TightRope conditions were statistically significant at $p<0.001$ and $p<0.001$, respectively, while the single- vs. dual-mini-TightRope were statistically significantly different at $p=0.015$.

CONCLUSIONS: The dual mini-TightRope fixation provided superior load-bearing and maintenance of trapezial space height compared to single mini-TightRope or LRTI procedures.

An Analysis of 583 Metacarpophalangeal Arthroplasties for the Management of Inflammatory Arthritis

Abstract ID: Poster 069

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PURPOSE: Metacarpophalangeal (MCP) arthroplasty has shown promise in treating inflammatory arthritis; however, there is a lack of studies comparing different implant designs and their effect on function. The purpose of this study was to assess the outcomes of MCP joint arthroplasty in inflammatory arthritis, with a comparison of three most common types of implants.

METHODS: Utilizing a single institution's joint registry, we examined 583 MCP arthroplasties performed in 142 patients with inflammatory arthritis from 1998 to 2012. The mean age at surgery was 61 years and a BMI of 25.63% involving the dominant extremity. 86% were females, 11% smokers, and 12% had diabetes mellitus (DM). Implant types included pyrocarbon (n=155), silicone (n=366), and SRA (n=61). Patient characteristics comparisons, with the exception of age, did not differ significantly between implants. For pyrocarbon, SRA, and silicone groups age averaged (53, 54, 65), females (81%, 89%, 88%), smokers (12%, 0%, 11%), and DM (12%, 3%, 11%).

RESULTS: There were 38 revision surgeries performed at a mean 2 years postoperatively. The 2-, 5-, and 10-year survival rates were 98%, 95%, and 87%, respectively. The 5-year survival rates for the pyrocarbon, SRA, and silicone implants were 91%, 84%, and 99%, respectively. Patients receiving a SRA (HR 3.42, $p<0.001$) and pyrocarbon (HR 2.60, $p=0.005$) had an increased risk of revision arthroplasty compared to silicone implants. Intraoperative fractures and use of cement also increased implant failure risk. There were 15 intraoperative complications involving a periprosthetic fracture, while postoperative complications included 19 dislocations, 2 heterotopic ossifications, 4 postoperative fractures, and 9 infections. Pyrocarbon implants were associated with an increased rate of dislocation ($p<0.001$) and HO ($p=0.02$). In those unrevised patients, at a mean 5 years (2-10) follow-up, preoperative to postoperative pain levels significantly improved ($p<0.01$). In unrevised implants, there was no significant change in total arc of motion, grip or pinch strength when compared to preoperative values. SRA implants were associated with a increased total arc of motion (51°) compared to pyrocarbon (42°) and silicone (44°) ($p=0.005$).

SUMMARY POINTS: MCP arthroplasty for inflammatory arthritis can be a successful motion sparing procedure with reasonable medium-term survival and low complications. Silicone prosthesis was associated with a higher survival rate than pyrocarbon or SRA. Patients experience predictable pain relief and maintenance of their motion.

Mid- to Long-Term Outcomes of Weilby Suspension Arthroplasty for the Treatment of Carpometacarpal Osteoarthritis

Abstract ID: Poster 070

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INTRODUCTION: The Weilby procedure is an accepted method to treat thumb carpometacarpal (CMC) osteoarthritis (OA). Although it is known to provide pain relief and improve thumb function in patients, there is a paucity of data concerning the mid- and long-term. The purpose of this study was to examine the outcomes of patients who have undergone a Weilby suspension arthroplasty and focus on hand function, complications, and need for reoperation.

METHODS: One-hundred eighty-six Weilby procedures were performed by the senior authors between 1994 and 2014. One hundred (54%) patients were followed for a minimum of 1 year of follow-up or until reoperation. No patient was revised prior to the 1-year time point. The cohort was made up of 75% females, with a mean age of 61 years. 90% of the cases were performed for primary OA of the CMC joint. Grip and appositional pinch strength, range of motion, as well as pain rating were recorded pre- and postoperatively. The mean follow-up was 4 years (range, 1-13 years).

RESULTS: There was an improvement ($P=0.01$) in radial abduction. Likewise, there was an improvement in palmar abduction, yet this did not reach statistical significance ($P=0.05$). The Weilby suspension arthroplasty led to improved pain, with only 7% reporting worse symptoms at final follow-up ($P<0.0001$). Two patients were revised for instability and continued pain. Both patients underwent a revision interposition arthroplasty at 19 and 92 months. The mean arthroplasty survival at the 2-, 5- and 10-year time points was 98%, 98%, and 91%, respectively. One patient had persistent basilar thumb pain and underwent a metacarpophalangeal joint arthrodesis at 15 months. Including these revisions, 7 patients underwent a reoperation for any cause, including pin removal (1), neuroma excision of the radial sensory branch (1), metacarpal closing wedge osteotomy for improved motion (1), and proximal row carpectomy for wrist pain (1). The mean reoperation free-survival at the 2-, 5- and 10-year time points was 93%, 91%, and 84%, respectively. There was no increased risk for reoperation based on gender ($P=0.17$) or age (age ≤ 60 yrs, $P=0.46$). In addition to these reoperations, 2 patients reported symptoms consistent with complex regional pain syndrome.

DISCUSSION: The Weilby suspension arthroplasty provides patients with an improvement in thumb motion and pain reduction. Revision and reoperation were uncommon with extended follow-up. This procedure provides a durable treatment option for patients with CMC arthritis, with a low complication rate, and significant improvement in patient outcome.

PEDIATRICS

Pediatric Total Knee Arthroplasty Long-Term Outcomes

Abstract ID: Poster 071

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INTRODUCTION: Management of pediatric patients with end-stage arthritis is challenging. Non-operative treatments may be ineffective and significantly impact quality of life. Pediatric total knee arthroplasty (TKA) is a rarely performed procedure that should be reserved for a very select patient population. Currently, minimal long-term data is available on the outcomes in this patient population. Our goal was to describe TKA for patients with end-stage arthritis who were 20 years of age and younger.

METHODS: The Joint Registry at our institution was utilized to identify all patients 20 years of age and younger that underwent a primary TKA. We included 29 TKAs in 19 patients and excluded any patients who underwent tumor reconstruction. Revision rates, complication rates, and patient outcomes were recorded. The average age of patients included was 18 years (range 14-20 years). The average follow-up was 14.5 years (range: 2.1-25.5 years). There were 3 males and 16 females.

RESULTS: The preoperative diagnoses were juvenile idiopathic arthritis (JIA) (n=19), avascular necrosis (AVN) (n=4), sepsis (n=2), trauma (n=2), dysplasia (n=1), and hemophilia (n=1). We noted a decrease in the number of TKAs performed for inflammatory arthritis over the last several decades. All patients underwent TKA with standard TKA implants. Implant survivorship at 5 and 10 years was 96% and 94%, respectively. The most common complications included arthrofibrosis (n=5), loosening (n=2), poly wear (n=2), infection (n=1), and drainage (n=1).

DISCUSSION: We identified a 95% 10-year implant survivorship utilizing standard TKA components in pediatric patients with end-stage knee arthritis. The complication rates were low, but included a high incidence of arthrofibrosis requiring manipulation. Since the widespread use of biologic rheumatoid medications, there have been drastic decreases in the number of patients requiring TKA. Additionally, performing a total knee arthroplasty in pediatric patients has significant long-term potential risks including infection and bone loss, but may provide significant pain relief and good long-term results, and, therefore, should be utilized with caution.

National Treatment Trends in Pediatric Supracondylar Humerus Fractures: Where Are They Treated Now?

Abstract ID: Poster 072

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INTRODUCTION: While there is a generally held belief in the United States that children with supracondylar humerus (SCH) fractures should receive their definitive care at large tertiary care centers by a pediatric orthopedist or orthopedic surgeons highly experienced in treating these injuries, there are no published nationwide data describing recent referral patterns.

METHODS: National trends in the treatment patterns, hospital characteristics, and regional differences in the treatment of children with SCH fractures were evaluated through review of the Nationwide Emergency Department Sample (NEDS) database from 2006-2011. Weighted estimates were determined and logistic regression analyses were performed to determine the hospital factors (region, trauma designation, teaching status, metropolitan, etc.) that influence treatment trends.

RESULTS: The rate of SCH fracture-related ED visits in children (ages 0-18) remained stable nationally at 60/100,000 children from 2006-2011, representing an estimated 49,286 ED visits in 2011 and accounting for 0.2% of all ED visits by pediatric patients. There was a trend toward decreasing surgical rates nationally from 2006 to 2011 (16.5% to 13.4%). Surgical rates generally differed significantly among hospital regions, and over time. There was a significant reduction in the rate of surgery/ED visit in the Northeast (28.0% to 16.3%; OR 0.5, 95% CI 0.26-0.96) and West (21.5% to 14.4%; OR 0.6, 95% CI 0.40-0.95) and a non-significant increase in the Midwest (9.3% to 16.3%; OR 1.91, 95% CI 0.6-5.9) from 2006-2011. Surgical rates remained stable in the South (11.4%-10.3%). The proportion of visits resulting in transfer from the ED increased significantly from 2007-2011 nationally (4.8% to 9.1%; OR 1.70, 95% CI 1.28-2.30), largely the result of a significant increase in transfers/visit in the Northeast (3.1% to 10.0%; OR 3.4, 95% CI 1.8-6.4) from 2006-2011. The remaining regions had modest increases in transfer rate/ED visit. There were significant differences in rates of surgery/ED visit when comparing trauma designation, teaching status, and metropolitan location (20.1% vs. 3.6%; OR 6.66, 95% CI 3.23-13.73, $p<0.0001$), with a 44% decrease in rate of surgery/visit from 2006-2011 in hospitals meeting none of these designations.

CONCLUSIONS: It appears that a “standard of care” in the treatment of pediatric SCH fractures is being established on a nationwide level as the transfer and surgical rates/ED visit by geographic region are converging to a similar rate nationally. Additionally, it is inferred that pediatric patients are increasingly receiving surgical treatment of SCH fractures at hospitals designated as trauma centers, teaching hospitals, and in metropolitan locations.

End-Stage Arthritis of the Hip in Teenagers: Fusion or THR, Has the Paradigm Changed?

Abstract ID: Poster 073

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INTRODUCTION: Before the past decade, both pediatric and arthroplasty orthopedic surgeons considered hip arthrodesis the procedure of choice for unilateral endstage arthritis of the hip in teenagers. As technology evolved to cementless fixation in THA and as encouraging results in teenagers were reported, more surgeons began considering THA a viable alternative to arthrodesis. Utilizing a survey jointly constructed by pediatric and joint replacement orthopedic surgeons concerning trade-offs between hip arthrodesis and hip arthroplasty, the authors polled members of the Pediatric Orthopedic Society of North America (POSNA) and American Association of Hip and Knee Surgeons (AAHKS). The purpose of this study was to determine whether there had been a switch in paradigm from recommending hip arthrodesis to hip replacement.

METHODS: We surveyed members of the POSNA and AAHKS. Respondents were asked to choose between a recommendation of THA or arthrodesis in four clinical vignettes. Vignette 1 presented the base case of an 18-year-old male of normal weight who was destined for a sedentary job. The subsequent vignettes varied one feature of the base case, specifically: the patient is overweight (vignette 2), female (vignette 3), and destined for an occupation involving manual labor (vignette 4). The survey also elicited respondents' attitudes to the risk-benefit and time tradeoffs involved in the treatment choice.

RESULTS: Of 672 respondents, 79% recommended THA in vignette 1, 66% recommended THA in vignette 2, and 85% recommended THA in vignette 3. In vignette 4, 39% recommended THA, 38% recommended hip arthrodesis, and 22% were neutral. In multivariable analyses, older surgeons had 2-6 times higher odds of recommending arthrodesis in all vignettes. Opinion regarding tradeoffs was divided. Surgeons who believed the treatment choice involved real tradeoffs between short- and long-term outcomes had much higher odds of recommending arthrodesis (base case: OR=17.30, 95% CI, 7.71-38.83) than surgeons who did not hold this view. Surgeons who believed that function in young adulthood was a priority over function later in life had much lower odds of recommending arthrodesis (base case: OR=0.09, 95% CI, 0.03-0.25).

CONCLUSIONS: Both pediatric and joint replacement orthopedic surgeons were more likely to recommend THA in teenagers with endstage arthritis of the hip with the exception of patients performing manual labor. Recommendations vary systematically with surgeons' age and with their attitudes regarding tradeoffs between life stages.

TUMOR

Shoulder Hemiarthroplasty for Malignant Tumors of the Proximal Humerus: A Consecutive Series of 57 Patients

Abstract ID: Poster 074

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BACKGROUND: Shoulder arthoplasty is considered in the setting of resection of malignant tumors of the proximal humerus in an effort to provide a functional extremity and achieve limb salvage. Currently, there is a paucity of data concerning the mid-term survival of a hemiarthroplasty (endoprostheses) of the proximal humerus with studies frequently combining benign and malignant conditions, or grouping endoprostheses from multiple areas of the body into one cohort. The purpose of this study was to examine a consecutive series of endoprosthetic replacements of the proximal humerus performed for a malignant process to evaluate (1) overall patient survival, (2) need for reoperation, and (3) postoperative complications including infection and amputation.

METHODS: We identified 57 patients who underwent a shoulder endoprosthesis for an oncological process of the proximal humerus from 1975-2013. Kaplan-Meier survival outcomes were assessed for overall survival and reoperation. Functional outcomes were measured using the Simple Shoulder Test (SST) and the American Shoulder and Elbow Score (ASES). The mean age was 58 years at the time of the surgery, with 54% of patients being female. The most common pathology was metastatic disease (n=28, 49%). All surviving patients had at least 1-year follow-up with a mean follow-up of 4 years. The mean time to death was 2 years.

RESULTS: The mean 5- and 10-year overall patient survival was 33%, and 11%. One patient underwent a forequarter amputation for tumor recurrence. In addition to this, four patients underwent a reoperation for other reasons, including ORIF of a periprosthetic fracture (n=2), local flap coverage for a wound complication (n=1), and removal of a painful granuloma (n=1). The mean postoperative shoulder abduction and external rotation were 49° (range 0-110°) and 19° (range 0-40°). Of the patients survived a minimum of 1 year, 88% had no to mild pain. The mean SST and ASES score were 3 (range 1-8) and 56.4 (range 20-80), respectively. Postoperative complications included nerve palsy (3.5%), humeral fracture (3.5%), DVT (1.7%), dislocation (1.7%), and superficial wound infection (1.7%).

DISCUSSION: Although patients typically succumb to their disease prior to implant failure, the results of our study seem to demonstrate that shoulder hemiarthroplasty provides a durable reconstructive option in the setting of a malignant process. The procedure provides pain relief in a vast majority of patients, although function is often times limited. In contrast to other studies, there were no cases of component revision.

Endoprosthetic Replacement for Malignant Tumors of the Proximal Femur: A Consecutive Series of 211 Patients

Abstract ID: Poster 075

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BACKGROUND: Endoprosthetic replacement is an option for reconstruction of the proximal femur to restore a functional extremity and achieve limb salvage. Although these prostheses are commonly used, they can be fraught with complications and are commonly revised. Currently, there is a paucity of data concerning the long-term survival of endoprostheses with studies frequently combining benign and malignant conditions, or grouping endoprostheses from multiple areas of the body into one cohort. The purpose of this study was to examine a consecutive series of endoprosthetic replacements of the proximal femur performed for a malignant process to evaluate (1) overall patient and implant survival, (2) need for reoperation, and (3) postoperative complications including infection.

METHODS: Using our institutions total joint registry, we identified 1,361 patients who underwent a total hip arthroplasty for an oncological process of the hip from 1969-2013. We excluded all patients that did not have an endoprosthesis placed for a malignant process, leaving a cohort of 211 patients. Kaplan-Meier survival outcomes and Hazard ratios were assessed for overall survival, reoperation, infection, and revision. Mean age was 59 years at the time of the surgery with 55% being male. The most common pathology was metastatic disease (n=123, 58%). All surviving patients had 1-year follow-up with a mean follow-up of 5 years (1-20 yrs). The mean time to death was 2 years (range 2 weeks-18 years). A bipolar component was used in 91% of patients.

RESULTS: The mean 5-, 10-, 15-, and 20-year overall survival was 26%, 14%, 12%, and 4%. In regards to survival of the implant, the 5-, 10-, 15-, and 20-year overall survival was 86%, 66%, 58%, and 31%. Hazard ratios showed an increased risk for revision, reoperation, and infection in patients ≤50 years of age and those with postoperative complications including hematoma and delayed wound healing. Likewise, osteosarcoma statistically increased the risk of infection. Postoperative complications included hematoma (4%), delayed healing (5.2%), periprosthetic fracture (4.2%), DVT/PE (4.2%), dislocation (8%), and component loosening (1%). There was no significantly increased risk of dislocation based on type component (THA vs. bipolar, OR 2.98, P=0.12).

DISCUSSION: Although patients typically succumb to their disease prior to implant failure, we believe endoprosthetic replacement of the proximal femur provides a durable reconstructive option in the setting of a malignant process. In contrast to other studies, we did not find an increase of dislocation in patients where a THA was used.

Disparities Among Limb-Salvage Rates in Pediatric Sarcoma Patients

Abstract ID: Poster 076

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INTRODUCTION: Racial and ethnic disparities in limb-salvage surgery have been reported among adult sarcoma patients. The purpose of this work was to explore treatment patterns by ethnicity, gender, and physical attributes in a cohort of pediatric sarcoma patients.

METHODS: A retrospective review was conducted of all consecutive patients under the age of 18 treated for sarcoma at the study institution with diagnoses from 1999 to 2011 who underwent surgery for limb salvage or amputation. Statistical analysis of patient demographics (age, gender, ethnicity, height, weight and BMI) was performed to assess for factors associated with limb salvage surgery.

RESULTS: 51 pediatric patients who underwent surgery for extremity sarcoma in the defined study period were included. Multivariate analysis was performed to evaluate for predictors of amputation. Male gender ($p=0.016$), increasing height ($p=0.007$), and elevated BMI were associated with greater likelihood of amputation. Hispanic ethnicity was not an independent predictor for amputation ($p=0.386$).

CONCLUSIONS: Male gender, increasing height, and elevated BMI were predictors of amputation in a cohort of pediatric sarcoma patients undergoing surgical treatment. Further study should be devoted to identifying underlying factors for gender discrepancies between treatment groups.

Implant Selection Criteria for Early Practicing Orthopedic Oncologists

Abstract ID: Poster 077

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With the wide arrange of megaprostheses on the market, it is ultimately the choice of an orthopedic oncologist as to which implant they prefer to use. To determine which factors are currently influencing surgeons in this decision, 25 surveys were mailed out to members of the Musculoskeletal Oncology Research Initiative and all 25 surveys were returned. The survey asked respondents to directly rank from very unimportant (0 points) to very important (4 points) certain preselected factors which would influence the surgeons decision as to which prosthesis to use in a salvage reconstruction. In addition to reviewing the most influential factors in choosing a megaprosthesis, the survey also allowed us to view any trends that may exist in training, location, number of implants performed per year, and their selection of a megaprosthesis. In those who returned surveys, 92% practice in an academic setting vs. 8% in a private setting. The majority, 56%, claim to perform 6-15 limb salvage surgeries with use of a megaprosthesis per year, while 24% perform >15 surgeries and 20% performed 1-5 surgeries per year. The most influential factor with an average rating of 3.52/4 was the belief that the prosthesis has the best outcome for the patients. This was followed by ease of use (3.28/4), modularity to add segments (3.16/4), use in fellowship (2.92/4), and good working relationship with representative (2.88/4). Other factors examined include cheapest cost to the hospital (2.2/4), cheapest cost to the patient (2.08/4), required due to hospital contract (1.56/4), used in residency (1.48/4), and worked as a consultant for the company (0.17/4). When asked to select an implant for a given scenario, 11 responders (44%) selected Stryker as well as Biomet-Compress fit, while 2 (8%) chose Depuy, and 1 (4%) chose Zimmer. Of the classic types of stems offered, osteointegrative was the favorite with 11 respondents (44%), followed by press-fit with 9 (36%), and cemented with 5 (20%). Early career orthopedic oncologist select implants based on perceived outcomes and ease of use. Financial factors appeared to play a lesser role, if any, in selection criteria. Future physician engagement by the industry should focus on factors related to quality as opposed to financial benefits.

Soft Tissue Sarcomas of the Foot and Ankle: An Analysis of Risk Factors for Local Recurrence and Survival

Abstract ID: Poster 078

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BACKGROUND: Soft tissue sarcomas of the foot and ankle are exceedingly rare. Currently, there is a paucity of data examining the outcomes of treatment and prognostic variables for survival. The aim of this study was to review our institution's experience with soft tissue sarcomas of the foot and ankle to identify factors affecting (1) overall survivorship, (2) disease specific survival, and (3) postoperative complications.

METHODS: We retrospectively reviewed the records of 62 foot and ankle soft tissue sarcomas (STS) treated with definitive surgery at our institution between 1992 and 2013. Cox hazard ratios were used to assess prognostic variables. Disease-free survival and overall survival were estimated using Kaplan Meier method. The cohort consisted of 35 males and 27 females; with a mean age at diagnosis of 45 years and a mean follow-up of 7 years.

RESULTS: The most common tumor subtypes was synovial sarcoma (n=16). A majority of the tumors were deep (64%) to the fascia. At the time of presentation, two patients were noted to have distant metastases. The mean tumor volume was 241.5 cm^3 and the mean maximum tumor dimension was 5.4 cm. Ultimately, negative margins were obtained in 97% of cases. Thirty-five (56%) patients underwent a limb salvage procedure and 27 patients had an amputation. Limb salvage failed in 2 patients, necessitating amputation for local recurrence. The overall limb salvage rate was 53%.

Local recurrence was observed in 9 patients and distant metastases in 15 patients. In terms of overall survival, tumors deep to the fascia and tumor recurrence significantly increased the risk of mortality. Likewise tumor size ≥3 cm in maximal dimension increased the risk of mortality. The 10-year overall and disease-free survival was 56% and 57%.

Post-treatment complications occurred in 15 (24%) patients. In analyzing risk factors for postoperative complications, it was found that patients having neoadjuvant radiation (HR 3.33, P=0.02) were at increased risk.

CONCLUSION: Local recurrence and development of distant disease was relatively common following wide excision of a soft tissue sarcoma of the foot and ankle. A high percentage of patients underwent an amputation; however, limb salvage was not associated with an increased risk of mortality. Tumors that were ≥3 cm in maximal dimension were associated with a worse overall survival. Further studies are needed to determine if a separate grading system is needed for soft-tissue sarcomas of the foot and ankle, which accounts for these aggressive, small tumors.

Unicameral Bone Cyst: Does Surgical Technique and Type of Graft Affect Clinical Outcomes?

Abstract ID: Poster 079

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INTRODUCTION: Unicameral Bone Cyst (UBC) is a common benign bone tumor with multiple treatment options. While the trend is away from open diaphysectomy and bone grafting procedures and towards percutaneous interventions, recurrence rates remain high and no defined algorithm exists. Recently, the type of bone grafting or injectable material used has emerged as a topic of controversy.

METHODS: We searched Medline, Cochrane, and EMBASE databases to identify all published studies prior to February 2015 reporting on the clinical outcomes in the treatment of “solitary bone cyst,” “unicameral bone cyst”, or “simple bone cyst”. Study data was aggregated for levels I-III based on each treatment method and type of injection, and weighted outcomes were calculated. Level IV studies were reported using descriptive statistics. The systematic review was performed according the PRISMA checklist.

RESULTS: 50 therapeutic studies (1 Level I, 20 Level III, 29 Level IV), including 2,378 cysts were eligible. Use of curettage and grafting (CG) compared to percutaneous injection (PI) had a lower risk of recurrence (37% vs. 66%; $p < 0.0001$), need for reoperation (26% vs. 59%; $p < 0.01$), and higher rates of clinical success according to the Modified Neer Outcome Rating System (MNORS) ($p<0.00001$). Similarly, continuous decompression was superior to PI for recurrence rates (49% vs. 65%; $p<0.01$), better MNORS healing ($p<0.01$). No difference existed between CG and decompression in relation to recurrence rate and MNORS. Both PI and CG had lower reoperation rates owing to the need for removal of the decompression hardware. Subgroup analysis of autogenous and allograft bone in CG shows no difference in the recurrence rates. Grouping of all cysts treated with PI had a recurrence rate after a single injection at 68%, but variation in the recurrence rate existed for MP (70%), BMA (53%), MP/BMA (43%), demineralized bone matrix (DBM) +/- BMA (32%), and bioceramic (12%).

DISCUSSION: Treatment of UBC has various modalities with no consensus on the ideal technique to achieve cyst healing. Despite the large number of studies, the literature has primarily been limited to retrospective reports and incomplete comparisons of treatment options. Although CG carries a higher morbidity than decompression and PI, it provides lower rates of recurrence or reoperation compared to the historical percutaneous alternatives. We believe more recent attempts to use DBM/BMA or bioceramics through PI may provide a less invasive way to achieve the same osteoconductive scaffold as in CG.

Ten Years of Cases from Recently-Trained Tumor Fellows: An Analysis of the ABOS Part II Database

Abstract ID: Poster 080

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INTRODUCTION: Prior work has identified case volume as a major concern for young orthopedic oncologists, with tumor surgery representing <60% of the overall practice of the majority of recently-trained fellows. Our goal was to investigate trends over time to determine if there have been changes in (1) the number of tumor fellows, (2) the median number of total and tumor cases, and (3) the proportion of subspecialty cases.

METHODS: The American Board of Orthopaedic Surgery (ABOS) Part II database was used to identify all cases performed by examinees who self-reported orthopedic oncology fellowship training between 2004 and 2013. A total of 117 candidates and 14,668 cases were available for analysis. Cases were categorized as “tumor”, “trauma”, “adult reconstruction”, and “other” based on Common Procedural Terminology (CPT) codes. Descriptive statistics were calculated and univariate analysis employed to determine differences over time.

RESULTS: During the first 5 years of the study period, the median number of candidates reporting orthopedic oncology fellowship training was 9 (range 7-13) compared to a median of 15 (range 9-17) in the second 5 years. For 2004-05, the median number of total cases performed by ABOS Part II examinees with orthopedic oncology fellowship training was 119 (range 48-203), and the median number of tumor cases was 55 (range 8-134). For 2012-13, the median number of total cases was 136 (range 38-287), and the median number of tumor cases was 40 (range 0-84). In 2004-05, tumor cases made up 45.4% of the total cases, while in 2012-13, tumor cases comprised 34.8% of the total cases ($p<0.001$). There was a corresponding increase in the proportion of trauma cases (22.6% in 2004-05 vs. 26.5% in 2012-13, $p<0.001$) and adult reconstruction cases (8.7% in 2004-05 vs. 18.0% in 2012-13, $p<0.001$). Only 34.2% of candidates (40/117) had tumor procedures account for more than half of their total case volume.

CONCLUSIONS: We found an increase in the number of candidates reporting fellowship training in orthopedic oncology in the later years of our study period. This corresponded with a decreasing proportion of tumor procedures and increasing proportion of trauma and adult reconstruction cases. However, the median number of total and tumor cases was fairly stable over time. While this is a unique cohort and our findings cannot be extrapolated to the general practice of orthopedic oncology, this establishes a benchmark for recent tumor fellows in their board collection period.

OTHER

The Cost of Getting into Orthopedic Residency: Analysis of Applicant Demographics and Expenditures

Abstract ID: Poster 081

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INTRODUCTION: It is well known that orthopedic surgery is one of the most competitive residencies for medical school graduates to match into, and a number of applicants go unmatched each year. Although some applicant data is publically available, relatively little is known about the demographics and expenditures of these applicants. The purpose of this study was to better understand who the matched applicants are and what they spend to get in.

METHODS: One week following the 2015 U.S. Residency Match, an electronic survey was sent to 1,091 applicants to orthopedic surgery residency. The survey focused on a multitude of applicant demographics, how many programs they applied to, and what they spent on the application and interview process. All survey responses were anonymous and deidentified. Although both unmatched and matched applicants were surveyed, the results were focused on those that matched.

RESULTS: The survey was completed by a total of 408 applicants for a response rate of 37%. Of these, 312 (76%) matched and 96 (24%) did not match into a U.S. Orthopedic Surgery Residency. Looking specifically at the matched applicants, 300 (96%) were from U.S. allopathic medical schools, 9 (3%) graduated from U.S. Osteopathic Schools, and 3 (1%) were international graduates. Males comprised 84% of these applicants while 16% were female. The mean number of programs applied to was 71 (range 20–140). On average, applicants were offered 16 interviews (range 1-53) and they attended 11 (range 0-12). The majority of applicants (188, 61%) matched where they rotated, and completing a rotation at a program increased an applicant’s chances of matching into that program by a factor of 7 (61% vs. 9%). Regarding expense, the average reported cost of the application alone was $1,664 (range $100 to $5,000) while the cost of interviews (travel, food, etc.) was $3,656 (range $15 to $20,000). Total cost ranged from $450 to $25,000 with a mean of $5,415. Nearly 10% of matched applicants spent >$10,000.

CONCLUSIONS: Gaining acceptance into orthopedic surgery residency remains a very competitive and expensive process. As a result, applicants are steadily applying to more programs, attending more interviews, and spending significant amounts of money. Accordingly, students applying to orthopedic surgery residency may benefit from appropriately directed cost containment measures.

Coaxial Polycaprolactone/Polyvinyl Alcohol Electrospun Nanofibers Enhance Implant Osseointegration in a Rat Tibial Pin Model

Abstract ID: Poster 082

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PURPOSE: Total joint replacement is successful and provides an attractive option for patients with disabling arthritis. Implant stability and longevity necessitates incorporation of an implant by bone formation at the bone-implant surface, also referred to as osseointegration. Defective osseointegration leads to implant instability, micromotion, and loosening.

Electrospinning technology represents a promising new technology to emulate the nanoscale extracellular matrix (ECM) of bone. We recently described the development of a novel coaxial electrospun polycaprolactone (PCL)/polyvinyl alcohol (PVA) core-sheath nanofiber (NF) blended with both hydroxyapatite (HA) and type I collagen (Col) (PCLCol/PVAHA), and found that these NFs bind firmly on the titanium rod surface, with no disruption during pullout testing. This technique provides a promising source for enhancing implant osseointegration and for local drug delivery at the implant-bone interface.

Erythromycin and strontium coatings on implants have been shown to have potential for enhancing osseointegration. However, the optimal vehicle for delivery of these compounds has not been elucidated. The aim of this continuation study was to determine the osseointegration efficiency of PCLCol/PVAHA NFs as an implant coating in a rat tibia model.

METHODS: Tibial pins were surgically inserted into 13 week Sprague-Dawley rats forming four different groups with eight rats in each group: (1) titanium pins alone (Ti), (2) titanium pins with NFs (NF), (3) titanium pins with NFs and strontium (NF+SR), (4) titanium pins with NFs and erythoromycin (NF+EM). Using micro computed tomography scanning performed in vivo at 0, 4, and 8 weeks, bone contact surface area was quantified to compare the effectiveness of osseointegration. Percent change in bone contact surface area between the implant and surrounding bone was analyzed between 4- and 8-week time points. Mechanical testing was also performed to assess the push out force to displace the implant from the bone interface.

RESULTS: A large increase was noted from 4 weeks to 8 weeks in bone contact surface area in all of the nanofiber groups compared to the titanium pins alone ($p<0.05$). Preliminary mechanical testing results showed the average force required to displace the implant was higher in the NF, NF+SR, and NF+EM groups compared to the Ti pin alone, but this difference was not significant ($p>0.05$).

CONCLUSION: PCLCol/PVAHA coaxial NFs could be applied as promising nanofabricated coatings with various biomolecules/drugs to promote early and efficient osseointegration, while simultaneously allowing for local drug delivery at the bone-implant interface, thus minimizing the potential for aseptic loosening, osteolysis, and ultimate implant failure.

Off the Cuff: Analysis of Intraoperative Moisture Under Surgeons' Gloves

Abstract ID: Poster 083

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INTRODUCTION: Surgical site infection continues to be one of the most common and expensive postoperative complications. Frequently, in an effort to mitigate such complications, orthopedic surgeons wear two pairs of surgical gloves, changing outer gloves prior to placing surgical implants and at the time of final dressing application. It has been recognized that moisture and possibly perspiration from surgeons' forearms or hands can accumulate in the proximal aspect of the glove cuffs. This moisture may contaminate the working surface of the gloves during changes, resulting in contamination of the surgical field. The sterility of this moisture remains unknown.

PURPOSE: To determine whether surgical gloves harbor non-sterile moisture, which may be associated with breeches in sterile technique and resulting contamination of the surgical field.

METHODS: After IRB review and statistical power analysis to determine sample size, orthopedic surgical cases at our institution were prospectively identified to include "clean" procedures, without assumption of infection or bacterial contamination, lasting a minimum of 1 hour. Orthopedic teams were requested to refrain from contacting the undersurface of their gloves during the procedure. Swab cultures were obtained by a single examiner for each glove cuff undersurface with the presence of visible moisture, and promptly sent for microbiology evaluation. A second group of unworn surgical gloves were swabbed and cultured after being opened to air and permitted to sit in an unused operating theater for two hours (control). Culture data was compared statistically between groups.

RESULTS: A total of 59 cultured specimens were reviewed, with 30 representing controls and 29 experimental, from 15 unique surgical team members (3 attendings, 2 fellows, 7 residents, 1 medical student, and 2 surgical techs.). One sample was not obtained due to a lack of visible moisture on the undersurface of one surgeon's left glove. Of the 15 surgical cases, 11 included fracture repair in the upper and lower extremity with plates and nails, and there were two cases each of foot fusions and nerve explorations. At a minimum of 72 hours of incubation, there were no positive cultures results from any specimen.

CONCLUSION: The authors conclude that the moisture often seen at the edges of surgeons' gloves has a similar sterility profile as that of unused gloves, and does not contain a substantial bacterial load, as investigators were unable to culture organisms from either group.

Safe Selection of Outpatient Joint Replacement Patients With Medical Risk Stratification: The OARA Score

Abstract ID: Poster 084

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INTRODUCTION: While there is substantial interest in outpatient joint replacement, risk stratification and patient selection criteria currently are crude and unreliable in the ambulatory setting. This study objective is to assess the validity of a medically-based risk stratification score in selecting patients for outpatient joint replacement surgery.

METHODS: A retrospective review of consecutive patients who underwent primary hip and knee arthroplasty in a high-volume academic practice with an early discharge program was performed. Patients underwent risk-assessment by a perioperative medical specialist. An Outpatient Arthroplasty Risk Assessment Score ("OARA Score") was developed to risk-stratify patients for outpatient joint replacement and categories are "low risk (0-29)", "moderate risk (30-59)", and "high risk/not appropriate (>59)". OARA Score, ASA classification, and Charlson Comorbidity Index were calculated for all patients. Statistical analysis was performed to correlate scores with early discharge and readmissions.

RESULTS: 682 patients had a mean age of 61.4 years and mean BMI 32.0. Mean OARA Scores for patients discharged same day and day after surgery was 22.0 and 27.5, respectively; vs. mean OARA Scores of 44.5 and 55.3 for day two and three, respectively ($p=0.001$). The positive predictive value of the OARA Score was 84.2% for same or next day discharge, compared to 63% for ASA classification score. The positive predictive value of the OARA Score was 67.5% for readmission within 90 days, compared to 35% for ASA classification. Readmission rates in this early discharge program for same or next day discharge were 2.5%, compared to 6.4% for day two or greater.

CONCLUSION: The OARA Score is a valid medical risk-stratification tool, accurately predicting the ability to undergo total joint arthroplasty in a same day or 23-hour outpatient program. The OARA Score has more precise predictive ability than the ASA classification with respect to early discharge and readmission.

SIGNIFICANCE: Accurate medical risk-stratification is an essential component of safe patient selection for outpatient joint replacement. The OARA Score is a valid tool that facilitates the assessment of patient appropriateness for hip or knee arthroplasty in the outpatient or ambulatory setting.

Outcomes and Radiographic Findings of Anatomical Press-Fit Radial Head Arthroplasty

Abstract ID: Poster 085

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BACKGROUND: Radial head arthroplasty (RHA) is a popular method of treatment for complex fractures of the radial head. The purpose of this study was to investigate patient outcomes and radiographic findings associated with a single anatomical monopolar press-fit radial head system commonly used for the treatment of radial head fractures.

METHODS: A retrospective review of prospectively collected data was performed for a consecutive series of patients treated with RHA between November 2007 and April 2014. Patients with a minimum of 12-month follow-up were included. Most recent radiographs were evaluated for loosening, stress shielding, and instability. Postoperative motion and outcomes were reported at most recent follow-up.

RESULTS: At an average follow-up of 30 months, 7 of the 17 patients (41%) demonstrated radiographic loosening. Six of the 10 patients (60%) without loosening demonstrated stress shielding (average 6 mm). Functional outcome scores included a mean ASES of 74, MEPS of 87, VAS Pain of 1, VAS Function of 8, and SANE of 79. Average flexion-extension arc was 13°-138°, and average pronation-supination was 77°-76°. Of the patients with radiographic loosening, 86% had undergone RHA with an associated ligamentous injury of the elbow. Satisfaction among patients was high, as no patient reported an unsatisfactory outcome.

CONCLUSIONS: The use of an anatomic, press-fit monopolar RHA in the management of acute complex radial head fractures has yielded excellent clinical outcomes despite high rates of radiographic loosening and stress shielding. Press-fit RHA in the setting of ligamentous injury warrants further investigation due to a high rate of implant loosening observed.

Prosthetic Infections in Primary Total Joint Arthroplasty in Patients With Various Solid Organ Transplants

Abstract ID: Poster 086

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INTRODUCTION: There has been an increase in the number of patients receiving solid organ transplantation in the United States. Improved surgical techniques and immunosuppressant drugs simultaneously increase life expectancy and place these patients at risk for fractures, avascular necrosis, and osteoarthritis requiring joint arthroplasty. Due to their medical co-morbidities and immunosuppressed states, we acknowledge a hypothetical increased predisposition of perioperative complications and infections after joint arthroplasty. We examined the prosthetic infection rate of patients with solid organ transplants undergoing total hip and knee arthroplasties (THA, TKA).

METHODS: We retrospectively reviewed all patients undergoing primary THA or TKA following solid organ transplantation at our institution between February 2007 and April 2015 with minimum 30-day follow-up. The primary outcome measures assessed were prosthetic infection, 30-day readmission rate, and death.

RESULTS: Sixty-three primary total joint arthroplasty procedures (37 THA and 26 TKA) in 49 solid organ transplant patients (19 kidney, 9 heart, 9 liver, 8 lung, 18 multiple organ) were identified. The leading diagnoses for arthroplasty were osteoarthritis (58%), aseptic necrosis of bone (28%), and femoral neck fracture (6.3%). The mean age at arthroplasty was 60 years (range 27 - 83 years), the mean time between transplant and arthroplasty was 10 years (range 9 months - 36 years), and the mean follow-up was 3 years (range 1 month - 8 years). Four patients (6.3%) were readmitted to our institution within 30 days of surgery. The principal diagnoses at readmission were prosthetic hip dislocation, fever, hyponatremia, and abdominal pain. Three patients (4.7%) were diagnosed with a deep infection at 19 days, 9.5 months, and at 4 years. The infecting organism was methicillin sensitive Staphylococcus aureus in one patient and unidentified in two patients. Eight (12.6%) deaths occurred at an average of 1.8 years post-arthroplasty (range 18 days - 4 years). No patients died from sequelae of prosthetic joint infection.

DISCUSSION: As the rate of solid organ transplants rises and these patients are living longer, more will present for total joint arthroplasty to seek improvement in functional status and quality of life. Most studies have reported improved function, pain relief, and better quality of life after arthroplasty in solid organ transplant patients. Our study shows a lower rate of prosthetic infection (4.7%) compared to previous studies in the literature. The risk of prosthetic infection should not exclude transplant patients from the known benefits of these procedures. Careful preoperative evaluation and close perioperative monitoring is recommended.

Radiation Exposure in Orthopedic Residency

Abstract ID: Poster 087

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INTRODUCTION: Radiation exposure to orthopedic surgeons has generally been felt to be below acceptable limits. However, research into this exposure is limited, often only assessing a given operation or sub-specialty. Research related to exposure in trainees is even further limited. Exposure to residents is of particular importance as they tend to use more fluoroscopy and there is increased risk of exposure when acting as an assistant.

METHODS: Ten orthopedic residents, 5 senior and 5 junior residents, wore whole body radiation dosimetry badges during all surgical cases in a given rotation. Each radiation badge was worn for 3 consecutive months. In total, 60 months of radiation dosimetry measurements were obtained. Deep dose equivalents were calculated based on each of these badges and correlated with the specific rotation that each resident was on.

RESULTS: The average yearly radiation dose over the course of this residency program is 162 mrem +/- 83 mrem. Our results showed significantly higher radiation exposure during orthopedic trauma rotations (122 mrem [+/-80 mrem]/3 months vs. 6 mrem [+/- 3 mrem]/3 months, $p<0.05$). There was a trend toward higher radiation exposure in senior residents vs. junior residents during orthopedic trauma training (170 mrem vs. 60 mrem), but this did not reach statistical significance. No single resident was exposed above the yearly recommended limit of 5000 mrem for a 1 year period for occupational radiation workers. However, the radiation exposure during 3 months on an orthopedic trauma rotation did routinely exceed the acceptable limit for the general public for an entire year (122 mrem/3 months vs. 100 mrem/year).

DISCUSSION: To date, this is the only known study looking at radiation exposure among U.S. trainees. Our study found that radiation exposure to residents is greatest during orthopedic trauma rotations. Given the current rotation schedule, our trainees exposure falls below the acceptable limits set for radiation workers by the U.S. Nuclear Regulatory Commission. However, several large database studies have demonstrated increased risks for cancer among pilots who receive a yearly radiation dose of approximately 200-500 mrem, well below the limit set for radiation workers. This level is within the 95% confidence interval for the average yearly radiation exposure for our residents.

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Brennan, Michael L.	3b - Stryker
Briggs, Daniel M.	n
Brindley, George W.	n
Brockman, Holly	n
Brogan, David M.	6 – Arthrex, Inc., Axogen
Brolin, Tyler J.	n
Brower, Richard S.	n
Bryan, Andrew J.	n
Buckwalter, Joseph A., V	n
Burchell, Patrick	n
Burkard, David J.	n
Burnham, Jeremy M.	n

Burns, Geoffrey T.	n
Busel, Gennadiy	n
Bushmiaer, Marty	4 – Stryker
Buvanendran, Asokumar	3b – consultant about multimodal analgesia; 4 – Vital 5; 5 - Pfizer
Buzas, David	n
Cabanela, Miguel E.	n
Caccavallo, Pete	n
Callaghan, John J.	1, 3b – DePuy, a Johnson & Johnson Company; 7 – Journal of Arthroplasty (Deputy Editor), Wolters Kluwer Health – Lippincott Williams & Wilkins
Calloway, Sean P.	n
Camp, Christopher L.	n
Campana, Rodrigo	n
Cannada, Lisa K.	n
Cantwell, Sean R.	n
Carlson, Jon B.	n
Cass, Joseph R.	n
Centeno, Leslie	n
Cerier, Emily	n
Chagin, Kevin	n
Chalmers, Brian P.	n
Chalmers, Peter N.	n
Chalus, Rhonda J.	n
Chambers, Monique C.	n
Chan, Justin	n
Chandrasekaran, Sivashankar	n
Chen, Antonia F.	3b – ACI, Joint Purification Systems; 5 – 3M, Myoscience; 7 – SLACK Incorporated
Chiu, Michael	n
Chmell, Samuel J.	3b – Iroko Pharmaceuticals, Pacira Pharmaceuticals
Chouhan, Vijit L.	n
Chudik, Steven C.	1, 3b – Arthrex, Inc.; 3b – Adventist LaGrange Memorial Hospital
Churchill, Jessica	n
Cil, Akin	3b (shoulder replacement) – Stryker
Clarke, Michelle J.	n
Clohisy, John C.	3b – Microport Orthopedics, Inc.; 3b, 5 – Smith & Nephew; 5 – Pivot Medical, Zimmer; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Cofield, Robert H.	1 – Smith & Nephew, DJO
Cohen, Joseph B.	n
Collins, Michael J.	n
Collis, Philip N.	n
Colman, Matthew	n
Connelly, Jacob O.	n
Conry, Keegan T.	n
Cook, James L.	1, 2, 3b, 5 – Arthrex, Inc.; 3b – Eli Lilly, Schwartz Biomedical; 5 – Coulter Foundation, DePuy, a Johnson & Johnson Company, Musculoskeletal Transplant Foundation, National Institutes of Health (NIAMS & NICHD), Nutramax, U.S. Department of Defense, Zimmer; 7 - Thieme
Cook, Shane	n
Cooley, Brian	n
Cooper, Tyler N.	n
Cooperman, Daniel R.	n

Cornett, Chris A.	n
Couch, Cory G.	n
Cox, Joseph T.	n
Cracchiolo, Allison M.	n
Crawford, Amanda	n
Crist, Brett D.	3b – DePuy, a Johnson & Johnson Company, KCI, MicroPort; 4 – Amedica Corporation, Orthopaedic Implant Company; 5 – Synthes; 6 – Wright Medical Technology, Inc.
Cross, William W., III	n
Crowder, Douglas	n
Crowe, Matthew M.	n
Cullinan, Kevin	n
Culp, Brian M.	n
Cummings, Nancy M.	4 - Cardiosolutions
Currier, Bradford L.	1 – DePuy, a Johnson & Johnson Company, Stryker; 1, 3b – Zimmer; 4 – Spinology Tenex; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Curtis, Gannon	n
Cvetanovich, Gregory L.	n
Dabov, Gregory D.	7 – Saunders/Mosby-Elsevier
Dahm, Diane L.	1,4 – TENEX health (spouse)
Dailey, Steven K.	n
Daly, Peter	n
Davies, James	n
Davis, Jason J.	n
Davison, Brian L.	n
Davison, Jeffrey B.	n
Dean, Daniel M.	n
deDeugd, Casey M.	n
DeFor, Terese A.	4 - Pfizer
Deirmengian, Gregory K.	2,5 – Zimmer; 3b – Biomet, Synthes, Zimmer; 4 – Domain, Trice; 4, 5 – CD Diagnostics; 7 – Journal of Bone & Joint Surgery-American
Del Gaizo, Daniel J.	2 – Cadence Pharmaceuticals; 3b – SPR Therapeutics; 5 – Stryker, Zimmer
del Rio, Alejandro M.	n
Delagrammaticas, Dimitri	n
Delaney, Joshua R.	n
Delgado, Domenica	n
Della Rocca, Gregory J.	2, 3b, 5 – Synthes; 3b – Bioventus, LifeNet, Pacira; 4 – Amedica, MergeNet, The Orthopaedic Implant Company
Della Valle, Craig J.	1, 3b, 5 – Biomet; 3b – DePuy, a Johnson & Johnson Company; 3b, 5 – Smith & Nephew; 4,5 – CD Diagnostics; 5 – Stryker; 7 – SLACK Incorporated, Wolters Kluwer Health – Lippincott Williams & Wilkins
Demzik, Alysen L.	n
Dennison, David G.	2 – AO (instructor for AO hand fracture course); 5 – DePuy, a Johnson & Johnson Company
Desai, Mihir J.	n
Deshpande, Chetan	n
Devers, Brandon N.	n
Dickinson, Christopher C.	n
Dietz, Frederick	n
Dilisio, Matthew F.	n
Dirschl, Douglas R.	3b - Stryker
Dixon, Tonya	n

Dolan, Lori	n
Domb, Benjamin G.	1 – DJO Global, Orthomerica; 1, 2, 3b, 5 – Arthrex, Inc.; 2, 5 – ATI; 3b – Amplitude; 3b, 5 – Pacira Pharmaceuticals; 3b, 4, 5 – Stryker; 5 – Breg
Donald, Bryan	n
Dowdle, Spencer B.	n
D'Souza, Dwayne	n
Dubiel, Matthew	n
Dubin, Jonathan	n
Duchman, Kyle R.	n
Dulaney-Cripe, Elizabeth	6 – DePuy, a Johnson & Johnson Company
Dupree, James Imanee	n
Duquin, Thomas R.	2, 3b, 5 - Biomet
Easton, Kenneth J.	3b – Alphatec Spine; 3c – Cutting Edge Spine
Ebinger, Thomas	n
Ebraheim, Nabil A.	n
Edelstein, Adam I.	n
Edwards, Paul K.	3b – Biomet, DJO
Egekeze, Nkem C.	n
Eggers, John P.	n
Eglseder, W. Andrew	n
El-Othmani, Mouhanad M.	n
Elattar, Osama	n
Elgafy, Hossein K.	n
Elhassan, Bassem T.	n
Elkins, Jacob M.	n
Ellermann, Jutta	n
Ellzey, Andrew	n
Elston, A.	n
Emerton, Eric D.	n
Entezari, Vahid	n
Epley, Chad	3a, 4 - Novartis
Erickson, Brandon J.	n
Esquivel, Amanda O.	n
Evans, Peter J.	1 – Extremity Medical, Hely Weber, Innomed; 1, 2 – Biomet; 2, 3b – Axogen; 4 – Nutek, Tenex
Falk, Vanessa L.	n
Farid, Monica	n
Fehrenbacher, Victor	n
Fehring, Keith A.	1, 2, 3b, 5, 6 – DePuy, a Johnson & Johnson Company
Fehring, T. K.	1, 2, 3b, 5 – DePuy, a Johnson & Johnson Company
Feldman, John F.	n
Femino, John E.	n
Feria-Arias, Enrique	n
Figgie, Mark P.	1 – Biomet, Lima; 4 – Mekanika; 5 - Zimmer
Fillingham, Yale A.	n
Finkler, Elissa S.	n
Fitz, David W.	n
Fitzgerald, Ryan	n
Fitzgerald, Steven J.	n
Floccari, Lorena V.	n
Fogel, Harold A.	n
Ford, Marcus C.	n
Formaini, Nathan T.	n

Fortin, Paul T.	3b – Smith & Nephew, Stryker, Wright Medical Technology, Inc.; 5 – Musculoskeletal Transplant Foundation
Frangiamore, Salvatore J.	n
Frank, Charles	n
Frank, Jonathan M.	n
Frank, Rachel M.	n
Friedman, Alan	n
Frisch, Nicholas B.	n
Fuchs, Daniel J.	n
Gagnier, Joel J.	n
Gajewski, Nicholas	n
Gale, Andrea L.	n
Gallo, Theresa	n
Gambone, Andrew	n
Gannon, Emmett J.	n
Gao, Yubo	n
Garber, Andrew	n
Garlow, Timothy J.	n
Garvin, Kevin L.	n
Gaumer, Gregory A.	n
Gebhart, Jeremy J.	n
Gelman, Scott E.	n
Georgiadis, Andrew	n
Gerlinger, Tad L.	3b – Smith & Nephew
Gilbert, Shawn	n
Gilbert, Theodore	n
Gilde, Alex K.	n
Gill, Kevin	n
Gill, Stephen W.	n
Gioe, Terence J.	4 – Eli Lilly, Johnson & Johnson
Gitelis, Steven	2b - Onkos
Giveans, M. Russell	3b – Ortholink Pty Ltd.
Glass, Natalie A.	n
Glenn, Margaret	n
Goetz, Devon D.	n
Goldstein, Wayne M.	1 – Innomed, Smith & Nephew; 1, 3b, 5 – DePuy, a Johnson & Johnson Company
Gonzalez-Vega, Omar	n
Gosselin, Michelle	n
Gossett, Leland E.	n
Grabowski, Gregory	2- DePuy, a Johnson & Johnson Company; 5 - Stryker
Graves, Christopher M.	n
Grayson, Chris W.	n
Graziano, Gregory P.	3c – Medtronic Sofamor Danek
Grear, Benjamin J.	n
Greber, Eric M.	3a - Stryker
Greene, Joseph	3b, 3c - Zimmer
Greer, Wesley S.	n
Griffin, William L.	1, 2, 3b, 5 – DePuy, a Johnson & Johnson Company; 5 - Zimmer
Grozenski, Andrew	n
Guanciale, Anthony F.	n
Guest, John Michael	n
Guetschow, Brian L.	n
Gui, Chengcheng	n

Guirguis, Albair	n
Gurd, David P.	n
Guthrie, S. Trent	n
Haas, Steven B.	1 – Innovative Medical Products, Inc.; 1, 2, 3b, 5 – Smith & Nephew; 4 – Ortho.Secure; 6 – APS Medical and Sports Technologies, Ltd.
Haidukewych, George J.	1, 3b – Biomet, DePuy, a Johnson & Johnson Company; 3b, 6 – Synthes; 4 – Orthopediatrics, Institute for Better Bone Health
Haleem, Ambar	n
Halvorson, Jason J.	n
Hammersma, Zackary	n
Hancock, Kyle J.	n
Hanley, Jessica M.	n
Hansen, Erik	n
Hanssen, Arlen D.	1 – Stryker; 7 – Elsevier
Harpole, Bethany G.	ericgreber@gmail.com
Harris, Joshua D.	5 – DePuy, a Johnson & Johnson Company, Smith & Nephew; 7 – SLACK Incorporated
Harris, Mark	n
Harston, Andrew R.	n
Hartigan, David	n
Hartman, Curtis W.	2, 3b, 5 – Smith & Nephew; 3c, 4 – Trak Surgical, Inc.; 5 – Pfizer
Hartman, Michael W.	n
Hartzler, Molly A.	n
Haynes, Jacob A.	n
Heck, Robert K., Jr.	1 – Wright Medical Technology, Inc.; 7 – Mosby Elsevier
Heidenreich, Mark J.	n
Heinsch, David J.	n
Hellman, Michael D.	n
Henderson, James	n
Hendrix, Steven T.	n
Hettrich, Carolyn M.	5 - Tornier
Higuera, Carlos A.	3b – Covidien;; 3b, 5 – KCl; 5 – Myoscience, Stryker
Hill, Brian W.	n
Hines, Beckie	n
Hire, Justin	n
Ho, Bryant S.	n
Ho, Jason	n
Ho, Sherwin S.	1, 2, 3b, 6 – Biomet; 6 – Athletico Physical Therapy Company, Bioskin, DJ Orthopaedics, Smith & Nephew: fellowship support through OREF, Breg: support for annual orthopedic course
Hoeffel, Daniel P.	1 – Zimmer; 2, 3b, 5 – DePuy, a Johnson & Johnson Company; 5 – OrthoCor Medical
Hogue, Matthew H.	n
Hollenberg, Sophie	n
Hollins, Anthony M.	n
Holmes, James R.	n
Holt, Joshua B.	n
Holzmeister, Adam	n
Hong, Paul S.	n
Hood, Brent R.	n
Hook, Alexander W.	n
Hopkins, Chris M.	n

Horberg, John	n
Horwitz, Daniel	1, 3b – Biomet; 3b – Cardinal Health; 5 - Synthes
Hotchkiss, William R.	n
Houdek, Matthew T.	n
Howe, Benjamin M.	n
Huang, Philip	n
Huang, Ronald	n
Hughes, John	n
Hultman, Kristi L.	n
Hundepool, Caroline	n
Hussey, Michael M.	n
Hutchinson, Mark R.	n
Hydrick, Josie	n
Iannotti, Joseph P.	1 – Integra, Tornier, Zimmer; 1, 2, 3b – DePuy, Synthes; 2 – DJ Orthopaedics; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Ilyas, Haariss	n
Incavo, Stephen J.	1 – Biomet, Innomed, Smith & Nephew, Wright Medical Technology, Inc.; 1, 3b, 4 – Zimmer
Inkrott, Bradley P.	n
Ireland, Mary Lloyd	n
Irwin, Todd A.	n
Ishikawa, Susan N.	n
Ishmael, Marshall	n
Israel, Heidi	n
Izadpanah, Ali	n
Jabara, Michael R. F.	n
Jackson, J. Benjamin, III	5 - Synthes
Jacobs, Joshua J.	4 – Implant Protection; 5 – Medtronic Sofamor Danek, Nuvasive, Zimmer
Jain, Margaret	n
Jalan, Somya	n
Jelsema, Timothy	n
Jew, Nicholas B.	n
Jiang, Jimmy J.	n
Jildeh, Toufic R.	n
Johnson, Darren L.	1 – Smith & Nephew; 3b, 5 – Smith & Nephew Endoscopy; 5 - DJ Orthopaedics; 7 - Elsevier
Johnson, Jeffrey E.	1 – Wright Medical Technologies, Inc.; 2 – Trimed; 3c, 4 – Crossroads Medical; 4 – Extremity Development Corporation, Midwest Therapy; 6 – Arthrex, Inc.- Institutional Support for Fellowship
Johnson, Staci R.	n
Jonard, Brandon W.	n
Jones, Caleb W.	n
Jones, Clifford B.	n
Jun, Bong Jae	n
Jung, Edward	n
Junko, Jeffrey T.	3b – Synthes, Tornier
Kaar, Scott G.	n
Kadakia, Anish R.	1 – Biomedical Enterprise; 1, 2, 3b, 5 – Acumed, LLC; 2, 5 – Synthes; 3b – BME, Celling; 7 – Elsevier, Lippincott Williams & Wilkins
Kadri, Omar	n
Kaeding, Christopher C.	3b, 5 – Biomet; 5 – DJ Orthopaedics, Smith & Nephew
Kakar, Sanjeev	3b – AM Surgical, Skeletal Dynamics; 3b, 5 – Arthrex, Inc.

Kakazu, Rafael	n
Kalra, Kunal	n
Kanneganti, Praveen	n
Karadsheh, Mark S.	7 - Orthobullets
Karam, Joseph	n
Karam, Matthew D.	n
Katcherian, David	5 - Biomimetic
Kayupov, Erdan	n
Kearns, Sean M.	n
Keene, James S.	n
Keeney, James A.	n
Keller, Jennifer	n
Keller, Robert A.	n
Kelly, Brandon J.	n
Kelly, Derek M.	2 – Medtronic; 7 – Elsevier Health
Kelman, Mark	n
Kelsheimer, Christopher	4 – Johnson & Johnson
Kempton, Laurence B.	n
Kfuri, Mauricio, Jr.	n
Khaleel, Mohammed A.	n
Kheir, M. M.	n
Kim, Isaac S.	n
King, Alexander H.	n
King, Brandon W.	n
Kircher, Michelle F.	n
Kirchner, John S.	1, 3b – Zimmer; 2 - Tornier
Klein, Sandra E.	5 – Midwest Stone Institute – PI on research grants
Klika, Alison K.	n
Kliethermes, Stephanie A.	n
Koehler, Daniel M.	n
Koh, Jason L.	3b – Aesculap/B.Braun, Arthrex, Inc.; 3b, 4 – Aperion
Kohen, Robert B.	3b – Arthrex, Inc.
Kok, Peter L.	n
Konigsberg, Beau S.	n
Kopp, Benjamin	4 – PFE, LGND, VRX, JNJ, EBIO, CTIC
Kraay, Matthew J.	3c – Scientific Advisory Board for Cellbank
Kroin, Ellen V.	n
Krych, Aaron J.	3b – Arthrex, Inc.; 5 – Arthritis Foundation, Histogenics
Krzak, Joseph	3b – NeuroCom – a division of Natus
Kurdi, Alexander J.	n
Kurowicki, Jennifer	n
Kuzma, A.	n
Kwasny, Mary J.	n
Lababidi, Suzanne	n
Ladd, Lauren M.	n
Lafferty, Paul M.	n
Landy, David C.	n
Lane, Mark K.	n
Larson, A. Noelle	n
Laughlin, Richard T.	2 – AO North America, Smith & Nephew, Synthes; 3b – Premier Health Partners Orthopaedic Institute, South Surgery Center, LLC , World Arthrosis Organization; 3c – Community Tissue Bank; 5 – Grants: AOFAS, Ohio Third Frontier, Orthopaedic Trauma Association, Wright State University Boonshoft School of Medicine

Law, Tsun Yee	n
Lawler, Ericka A.	n
Lawrence, John T. R.	1 – Sawbones/Pacific Research Laboratories; 4 – Practice Medical Instruments, LLC
Lawton, Jeffrey N.	3b – Innomed; 5 – Synthes; 6 – AO North America
Le, Theodore T.	n
Lee, Cody	n
Lee, Edwin S.	3a – Gilead Sciences; 4 – Eli Lilly, Johnson & Johnson, Pfizer
Lee, Jessica H.	5 – Arthrex, Inc.
Lee, Kyla R.	n
Lemos, Stephen E.	5 – Arthrex, Inc., CONMED Linvatec, DePuy, a Johnson & Johnson Company, Smith & Nephew
Lenters, Timothy R.	2 – Mitek; 3c – Arthrex, Inc.; 6 – DJ Orthopaedics
Levine, Brett R.	3b – Link Orthopaedics, McGraw-Hill, Orthoview; 3b, 5 – Zimmer, 5 – Biomet
Levy, Bruce A.	1 – VOT Solutions; 1, 3b, 5 – Arthrex, Inc.; 5 – Biomet, Stryker
Levy, Jonathan C.	1 – Innomed; 1, 3b, 5 – DJ Orthopaedics
Lewallen, David G.	1 – MAKO/Stryker; 1, 2, 3b – Zimmer; 1, 3b – Pipeline Biomedical Holdings; 3b – Link Orthopaedics; 3c, 4 – Ketai Medical Devices; 4 - Acuitive
Liberman, Shari R.	n
Lieberman, Jay R.	1, 3b – DePuy, a Johnson & Johnson Company; 4 – Hip Innovation Technology; 7 – Saunders/Mosby-Elsevier
Lin, Albert B.	n
Lintner, David M.	n
Lodhia, Parth	n
Liu, Jiayong	n
Liu, Raymond W.	6 – Orthopediatrics: royalties paid to my institution
Lombardo, Daniel J.	n
Lonstein, John E.	n
Louer, Craig	n
Lovecchio, Francis	n
Lovro, Luke R.	n
Luchetti, Timothy J.	n
Lukens, Scott	n
Mabry, Tad M.	n
Macalena, Jeffrey A.	2 – Arthrex, Inc., Smith & Nephew, Vericel
Mahoney, Craig R.	3b,5 – Smith & Nephew; 5 – Liventa Biosciences
Mahmood, Syed H.	n
Majid, Mohommad S.	n
Malkani, Arthur L.	1, 2, 3b, 5 – Stryker; 5 - Synthes
Malkawi, Ibraheem	n
Maltenfort, Mitchell G.	n
Mancini, Eric J.	n
Manning, Blaine T.	n
Manning, David W.	1, 3b – Biomet; 2, 3b – Medacta; 4 - Iconacy
Marberry, Kevin M.	4 – Universal Research Solutions
Marchwiany, Daniel A.	n
Markel, David C.	1, 2, 3b, 5 – Stryker; 4 - The CORE Institute; 5 – OREF
Markert, Ronald J.	n
Markiewitz, Andrew D.	7 – American Board of Orthopaedic Surgery, Inc., CRC Press
Marinello, Patrick G.	n
Marra, Guido	1, 3b - Zimmer
Marsh, J. Lawrence	1 – Biomet, Tornier; 4 – FxRedux; 7 – Oxford Press

Marshall, Nathan E.	n
Martin, Christopher T.	6 – Globus Medical, Medtronic
Martin, John R.	3b - Biomet
Martin, Valerie A.	n
Martusiewicz, Alexander	n
Maschke, Steven	n
Mascioli, Anthony M.	3b – Smith & Nephew
Matelic, Thomas M.	n
Matta, Joel	1 – Mizuho OSI; 3b – DePuy, a Johnson & Johnson Company, Medtronic Sofamor Danek, Stryker; 3b, 4 – Invuity, Inc.; 4 – Radlink Corp.
Mauck, Benjamin M.	3b – Olympus Endowscopy
Mayman, David J.	2, 3b – Smith & Nephew; 4 – OrthAlign
Mazmudar, Aditya	n
McAlister, Ian P.	n
McCarthy, Kevin C.	n
McCarthy, Mark A.	n
McCarthy, Richard E.	1, 2, 3b, 7 - Medtronic
McCormick, Jeremy J.	2 – Synthes Integra; 5, 6 – Midwest Stone Institute, Wright Medical Technology; 6 – Arthrex, Inc.
McCulloch, Patrick C.	2 – Vericel
McCullough, Frances L.	n
McDonald, Katelyn	n
McGee, Corey	n
McIntosh, Amy L.	n
McKee, Michael D.	1 – Elsevier, Inc., Stryker; 1, 7 – Springer; 3b – Acumed, LLC, Synthes; 3b,5 – Olympus Biotech, Zimmer; 5 – Wright Medical Technology, Inc.; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
McKinley, Todd O.	3b - Bioventus
McLaughlin, Jeffrey R.	1, 2, 3b, 5 - Biomet
McLendon, Paul B.	n
McQueen, Peter D.	n
Medairos, Robert A.	n
Meehan, Robert E.	n
Megnemi, Megan	n
Meheux, Carlos J.	n
Mehran, Nima	n
Mehrotra, Kapil	n
Mejia, Alfonso	5 – Acumed, LLC, Arthrex, Inc., Smith & Nephew, Synthes
Meldau, Jason E.	n
Mendoza-Lattes, Sergio A.	2, 3b – Globus Medical
Meneghini, R. Michael	1, 3b – DJ Orthopaedics, Stryker
Mesko, Daniel	n
Mihalko, William M.	1, 2, 3b, 5 – Aesculap/B. Braun; 2 – CeramTec; 3b – Medtronic, Panoramic Healthcare Corp.; 5 – MicroPort, Smith & Nephew, Stryker; 7 – Saunders/Mosby-Elsevier, Springer
Milam, Adam J.	n
Milbrandt, Todd A.	n
Miller, Benjamin J.	n
Miller, Eric T.	3b, 3c - Synthes
Miller, Kevin D.	n
Miller, Ryan E.	n
Miller, Scot D.	1- Biomet
Milles, Jeffrey L.	n

Ming, Bryan	n
Mir, Hassan R.	2 – Synthes; 3b – Smith & Nephew; 4 – Core Orthopaedics
Mitchell, Joseph	n
Moed, Berton R.	1 - Biomet
Moisan, Alison	n
Molloy, Robert M.	2, 3b, 5 – Stryker; 5 - Zimmer
Momaya, Amit M.	n
Monroe, Emily J.	n
Moran, Steven L.	1, 3b – Integra; 3c, 4 – Axogen, Conventus
Moric, Mario	3b - Zimmer
Mormino, Matthew A.	3b – Cardinal Health
Morrey, Mark E.	4 – Tenex Health
Morris, Michael J.	3b, 5 – Zimmer Biomet; 5 – Kinamed, Orthosensor, Pacira Pharmaceuticals, SPR Therapeutics, LLC
Morris, William Z.	n
Morscher, Melanie A.	n
Moussa, Fouad	n
Moutzouros, Vasilios	n
Muh, Stephanie J.	n
Mulligan, Ryan P.	n
Mullis, Brian	2, 3b - Biomet
Munns, Stephen W.	n
Muriuki, Muturi	n
Murphy, G. Andrew	3b – Wright Medical Technology, Inc.; 5 – Allostem, Arthrex, Inc., Biomimetic, Smith & Nephew; 7 – Saunders/Mosby-Elesvier
Murray, Amanda	n
Murtha, Yvonne M.	n
Mutch, Jennifer	n
Myeroff, Chad D.	n
Myers, Faith M.	n
Nam, Denis	3b – KCI; 4 – OrthAlign Inc.; 5 – EOS Imaging
Nassr, Ahmad	2 – Magnifi Group; 5 – AO Spine, Pfizer, Synthes
Navale, Suparna	n
Neary, Kaitlin C.	n
Nelson, Bradley J.	5 – Histogenics, Zimmer
Nelson, Gerald, B.	n
Nepple, Jeffrey J.	2, 3b – Smith & Nephew
Nessler, Joseph M.	1, 2, 3b, 4 – Stryker; 4 - Vomaris
Nessler, Joseph P.	1, 2, 3b, 4, 6 - Stryker
Newbern, D. Gordon	4 – Pacira Pharmaceuticals
Nho, Shane J.	3b – Ossur; 3b, 5 – Stryker; 5 – Allosource, Arthrex, Inc., Athletico, DJ Orthopaedics, Linvatec, Miomed, Smith & Nephew; 7 - Springer
Nicholson, Nathan A.	n
Niedermeier, Steven R.	n
Nikolaus, O. Brant	n
Noehren, Brian	n
Noiseux, Nicolas O.	3b – MicroPort, Smith & Nephew; 5 – DePuy, a Johnson & Johnson Company, Zimmer
Nord, Ashley	4 – Johnson & Johnson
Nordin, James D.	n
North, Trevor	n
Novak, Kimberly	n
Nudelman, Brandon	n
Nuelle, Clayton W.	n

Nunley, Ryan M.	1, 3b – Microport; 3b – Biocomposites, Blue Belt Technology, Cardinal Health, Integra Sciences, Medtronic, Polaris; 3b, 5 – DePuy, a Johnson & Johnson Company, Smith & Nephew; 5 – Biomet, Medical Compression Systems, Inc., Stryker
Nypaver, Christina	n
Nystrom, Lukas M.	n
Oak, Nikhil	n
Oakes, Daniel A.	3b - Zimmer
Obey, Mitchel R.	n
O'Brien, Virginia	7 – Books on Hand
Ochenjele, George	n
O'Donnell, Jeffrey A.	n
Okoroafor, Ugochi C.	n
Okoroha, Kelechi R.	n
Olson, Jeffrey	n
Olson, Joshua T.	n
Olson, Tyler S.	n
Opsitnick, Kathleen A.	n
O'Shaughnessy, Maureen A.	n
Osterman, Meredith N.	n
Otero, Jesse E.	n
Otte, R. Stephen	n
Owashi, Eric T.	n
Padley, Michelle A.	n
Pagnano, Mark W.	1 – DePuy, a Johnson & Johnson Company, Stryker; 3b – Pacira Pharmaceuticals
Pallante, Graham D.	n
Pancio, Steven I.	n
Paprosky, Wayne G.	1, 3b – Stryker, Zimmer; 1, 4 – Intellijoint; 3b – DePuy, a Johnson & Johnson Company, Medtronic; 6 – Cadence Health; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Pareek, Ayoosh	n
Park, Kwan J.	n
Parker, Richard D.	1, 3b – Smith & Nephew
Parry, Joshua A.	n
Parvizi, Javad	3b, 5 – Smith & Nephew, Zimmer; 4 – CD Diagnostics, Hip Innovation Technology, PRN; 5 – 3M, Cempra, CeramTec, DePuy, a Johnson & Johnson Company, National Institutes of Health (NIAMS & NICHD), OREF, StelKast, Stryker; 7 – DataTrace, Elsevier, Jaypee Publishing, SLACK Incorporated, Wolters Kluwer Health – Lippincott Williams & Wilkins
Patel, Jay N.	n
Patterson, Jason	n
Peers, Sebastian C.	n
Pelle, Dominic W.	n
Pensy, Raymond A.	n
Pepper, Andrew M.	n
Perets, Itay	n
Petersen, Kyle A.	n
Petersen-Fitts, Graysen R.	n
Peterson, Edward	n
Peterson, Hamlet A.	n
Pfeiffer, Ferris M.	n
Phelps, Kevin	n

Phillips, Caleb T.	n
Phillips, Craig S.	3b, 4 - Tornier
Phisitkul, Phinit	3b – Arthrex, Inc., Smith & Nephew; 4 – First Ray, Mortise Medical
Phruetthiphat, Ong-art	n
Pifel, Eric B.	2 – Vericel; 4 – Midwest orthopedic Specialty Hospital (part ownership)
Pinzur, Michael S.	2 – Smith & Nephew; 2, 3b – Stryker, Wright Medical Technology, Inc.
Piponov, Hristo	n
Place, Howard M.	n
Plachta, Stephen M.	n
Planchard, Ryan F.	n
Plummer, Darren	n
Podeszwa, David A.	n
Ponce, Brent A.	2 – Mitek; 2, 3b, 5 – Tornier; 3b – Acumed, LLC; 4 – VIPAAR; 5 – Arthrex, Inc.
Popper, Joseph	n
Post, Joel M.	n
Potter, G. David	n
Prince, Matthew R.	n
Pugely, Andrew J.	n
Purtill, James J.	n
Putnam, Sara M.	n
Qatu, Mossub	n
Raberding, Craig	n
Rajani, Rajiv	3a – Avicenna Media LLC; 3b – Synthes; 4 – Johnson & Johnson, Pfizer
Ramsey, Matthew	n
Ramthun, Kyle W.	n
Ratkowiak, Kaitlyn	n
Reams, Robert C.	n
Reardon, Patrick J.	n
Reddy, Sundara	n
Rees, Harold W.	n
Ren, Weiping	n
Replogle, William H.	n
Rhodes, Leslie	n
Riboh, Jonathan C.	n
Ricchetti, Eric T.	2,5 – DePuy, a Johnson & Johnson Company
Rice, Olivia M.	n
Richardson, David R.	3b – Extremity Medical, Olympus Medical; 7 – Saunders/Mosby-Elsevier
Riehl, John T.	2, 3b – Arthrex, Inc.
Ries, Zachary G.	n
Riester, Scott M.	n
Rinaldi, Caroline E.	n
Rizzo, Marco	n
Roberson, Paula K.	n
Roberts, Craig S.	7 – Elsevier
Robertson, Daniel S.	n
Robertson, Michael W.	n
Robinson, Luke P.	4 – Johnson & Johnson
Robinson, William A.	n
Rodriguez, Ricardo J.	1 – Smith & Nephew; 4 - Vector
Rogers, Thea J.	n
Rohr, Sara	n

Romeo, Anthony A.	1, 2, 3b, 5, 6 – Arthrex, Inc.; 5 – DJO Surgical, Ossur, Smith & Nephew; 7 – Saunders/Mosby-Elsevier, SLACK Incorporated
Romero, Jose A.	n
Rooney, Edward	n
Rosas, Humberto G.	n
Rosas, Samuel	n
Rose, Peter S.	3b – K2M, Inc.
Rosenberg, Aaron G.	1, 2, 3b, 4 – Zimmer; 7 – Wolters Kluwer Health - Lippincott
Ruch, David S.	1 – Zimmer; 1, 2 – Acumed, LLC; 5 - Synthes
Rud, Christopher	n
Rungprai, Chamnanni	n
Russo, Scott S.	2 – Medtronic Sofamor Danek; 4 – Micromachines, Pfizer
Ryan, Holly S.	n
Ryan Michael J.	n
Ryssman, Daniel B.	n
Sabbag, Orlando D.	n
Sabesan, Vani J.	3b – Arthrex, Inc.; 5 – Exactech, Inc., Tornier
Safadi, Fayez F.	n
Sahota, Shawn	n
Saint-Preux, Fabienne	n
Salari, Pooria	n
Saleh, Khaled J.	1, 2, 3b – Aesculap/B.Braun; 3b – Memorial Medical Center Co-Management Orthopedic Board, Watermark Inc. – DSMB; 7 – Elsevier Science
Saltzman, Matthew D.	1, 3b – Tornier; 3b – Medacta
Samtani, Rahul G.	n
Samuelsen, Brian T.	n
Sanchez-Sotelo, Joaquin	1, 2, 5 – Stryker; 2 – Merck; 3b – Tornier; 7 – Elsevier, Journal of Shoulder and Elbow
Sandberg, Benjamin C.	n
Santoyo, Jose	n
Sasala, Lee M.	n
Sassoon, Adam A.	n
Savin, David D.	n
Sayeed, Zain	n
Scaife, Steve L.	n
Scannell, Brian	n
Scharschmidt, Thomas J.	5 – Millenium Pharmaceuticals
Schell, Benjamin A.	3a – Caldera Medical
Schiff, Adam P.	3b – Sonoma, Stryker
Schiltz, Nicholas	n
Schmidt, Courtney L.	n
Schneiderman, Brian A.	1 – DePuy, a Johnson & Johnson Company, Medtronic
Schoch, Bradley S.	n
Schraut, Nicholas B.	n
Schroeder, Amanda J.	n
Schupbach, Drew	n
Schwartz, Aaron	n
Schwartz, Brian E.	3a – Abbott
Scott, Jay	n
Sculco, Peter K.	n
Sebastian, Arjun S.	n
Sems, S. Andrew	1, 3b - Biomet
Shah, Apurva S.	n

Shah, Ashish	n
Shakir, Irshad A.	n
Shaughnessy, William J.	n
Shaw, Jonathan	n
Shen, Mary R.	n
Shi, Lewis L.	n
Shin, Alexander Y.	1 – Trimed
Shirazi, Cameron	n
Shives, Thomas C.	n
Shreve, Mark	n
Sidagam, Vasu	n
Siebler, Justin C.	2 - Synthes
Sierra, Rafael J.	1, 2, 3b, 5 – Biomet; 3b – Link Orthopaedics; 5 – DePuy, a Johnson & Johnson Company, Stryker, Zimmer
Sietsema, Debra L.	2, 3b – Eli Lilly
Sikora-Klak, Jakub	n
Silverstein, Michael P.	n
Silverton, Craig D.	1 - Biomet
Sim, Franklin H.	7 – Saunders/Mosby-Elsevier
Simcock, Xavier	n
Simpson, Jordan B.	n
Sigueira, Marcelo B. P.	n
Sittapairoj, Tinnart	n
Skie, Martin	n
Slater, Robert R., Jr.	1 – Folsom Surgery Center; 1, 3c – Instrument Specialists, Inc.; 2 – Pacira Pharmaceuticals
Slayman, Taylor	n
Smith, Langan S.	n
Smith, Matthew J.	2, 3b – Arthrex, Inc.; 3b – Zimmer; 5 - Tornier
Smith, Patrick A.	1, 2, 3b, 5 – Arthrex, Inc.; 4 – Spinal Simplicity
Smith, Peter A.	n
Smith, Richard A.	n
Smith, Ryan	n
Somerson, Jeremy	n
Songy, Chad E.	n
Sorce, Angelo J.	n
Sorkin, Anthony T.	2, 3b, 4 – Stryker; 4 – Johnson & Johnson
Southam, Brendan	n
Sousa, Paul L.	n
Spanyer, Jonathon M.	n
Spears, James R.	n
Sperling, John W.	1 – Biomet, DJ Orthopaedics; 3b - Tornier
Spinner, Robert J.	3b – Mayo Medical Ventures; 7 – Saunders/Mosby-Elsevier
Sporer, Scott M.	3b – Pacira Pharmaceuticals, Smith & Nephew; 3b, 5 – Zimmer; 5 – Central Dupage Hospital, Stryker; 7 – SLACK Incorporated
Springer, Bryan D.	2 – CeramTec, DePuy, a Johnson & Johnson Company; 3b – Convatec, Polaris, Stryker; 6 – Joint Purifications Systems
Srivastava, Karan	n
Stahl, Daniel L.	n
Stambough, Jeffrey B.	n
Stammen, Kari L.	n
Stannard, James P.	3b – Ellipse Technologies, Inc., Regeneration Technologies, Inc., Smith & Nephew; 3b, 5 – Arthrex, Inc., DePuy, a Johnson & Johnson Company; 5 – Synthes; 7 - Thieme

Stans, Anthony A.	n
Statz, Joseph	n
Steensma, Matthew R.	n
Steffes, Matthew P.	n
Steinmann, Scott P.	1 – IMDS; 1, 3b – Arthrex, Inc., Biomet; 3b – Articulinx, Elsevier
Stephenson, John M.	n
Stern, Peter J.	n
Stewart, Matthew G.	n
Stewart, Robert J.	n
Stoner, Julie	n
Stotts, Alan	n
Strotman, Patrick K.	n
Stuart, Michael J.	1, 3b – Arthrex, Inc.; 5 - Stryker
Stubbart, James R.	n
Stuck, Logan	n
Studdert, David	4 – Bristol-Myers Squibb
Stuhlman, Casey R.	n
Stulberg, Bernard N.	1, 3b – Exactech, Inc.; 2 – Medtronic, Pacira Pharmaceuticals; 5 – Corin USA
Su, Edwin P.	2b, 5 – Smith & Nephew; 4 – OrthoAlign, Inc.
Suarez-Ahedo, Carlos	n
Sucato, Daniel J.	1 – Globus Medial; 5 – DePuy, a Johnson & Johnson Company; 7 – Saunders/Mosby-Elsevier
Suleiman, Linda I.	n
Sullenbarger, John	n
Sunderland, Adam	n
Sutak, Alan K.	n
Sveom, Daniel	n
Swann, Matthew C.	n
Switzer, Julie A.	5 - Stryker
Tait, Mark A.	n
Taliwal, Rajiv V.	n
Tan, Timothy	n
Tannenbaum, Eric P.	n
Taunton, Michael J.	3b – DJ Orthopaedics; 5 - Stryker
Tawari, Akhil	5 - Synthes
Terry, Marisa J.	n
Terry, Michael A.	1, 5, 6 – Smith & Nephew; 6 – Arthrex, Inc.; 7 – Saunders/Mosby-Elsevier
Terzaghi, Clara	n
Throckmorton, Thomas W.	2, 3b, 5 – Biomet; 3b – Zimmer; 4 – Gilead; 7 – Saunders/Mosby-Elsevier
Titan, Ashley	n
Tofte, Josef N.	n
Tompkins, Marc	n
Toney, Victor	n
Toohey, John S.	n
Toolan, Brian C.	4 - Pfizer
Toy, Patrick C.	3b - Biomet
Trousdale, Robert T.	1, 3b – DePuy, a Johnson & Johnson Company
Trousdale, Will	n
Truchan, Susan	n
Turner, Norman S.	n
Urchek, Ryan J.	n

Uribe-Echevarria Marbach, Bastian	n
Vaidya, Rahul	1 – Smith & Nephew; 1, 2, 5, 6 – Synthes; 2, 3b, 3c – Stryker
Vallier, Heather A.	n
Van Demark, Robert E., III	n
Van Heest, Ann E.	n
van Holsbeeck, Marnix	4 – Bristol-Myers Squibb, Johnson & Johnson, Norvartis; 4, 5 – GE Healthcare; 5 – Siemens Healthcare; 7 – MedEd 3D
Van Nortwick, Sara S.	n
van Veen, Steven	n
van Wijnen, Andre	n
Varcadipane, Joseph	n
Varner, Kevin E.	1, 3b – Solana; 4 – Wright Medical Technology, Inc.
Vemula, S. Pavan	n
Verma, Nikhil	1, 3b, 5 – Smith & Nephew; 3b – Orthospace; 3b, 4 – Minivasive; 4 – Cymedica, Omeros; 5 – Arthrex, Inc., Arthrosurface, Athetico, ConMed Linvatec, DJ Orthopaedics, Miomed, Mitek; 7 – Vindico – Medical Orthopedics Hyperguide
Verma, Rajat	n
Vernon, Brian	n
Vincent, Scott A.	n
Virkus, Walter W.	3a – Novartis; 2, 3b – Smith & Nephew; 2, 3b, 4 – Stryker; 3b – Collplant; 4 – Johnson & Johnson; 7 – SLACK Incorporated
Vittetoe, David A.	n
Volgas, David A.	n
Voss, Benjamin A.	n
Wagner, Eric R.	n
Walch, Gilles	1, 6 – Tornier; 6 - IMASCAP
Walia, Piyush	n
Walker, Alex	n
Walker, Kyle	n
Walsh, Christopher P.	n
Walters, Jordan D.	n
Walters, Ryan	n
Wang, Hongmei	n
Warner, Jon J. P.	1, 3b – Tornier; 4 – IMASCAP Company, Orthospace; 6 – Arthrex, Inc., Breg, DJ Orthopaedics, Smith & Nephew
Warth, Lucian C.	n
Watson, J. Tracy	1, 2 – Biomet, Smith & Nephew; 3b – Acumed, LLC, Bioventus; 3c – Ellipse
Watts, Chad D.	n
Weinberg, Douglas S.	n
Weiner, Dennis S.	n
Weinstein, Stuart L.	7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Weis, Marcia	n
Weisman, Martin H. S.	n
Weller, Segolene E.	n
Weller, William J.	n
Wenzlick, Thomas S.	n
Wera, Glenn D.	n
Werthel, Jean David	n
Wessell, Nolan M.	n
Westerlind, Brian O.	n
Westermann, Robert W.	n
Weston, John T.	n

Westrich, Geoffrey H.	2 – Mallinckrodt Pharmaceuticals; 2, 3b, 5 – DJ Orthopaedics, Exactech, Inc., Stryker
Wetters, Nathan G.	n
Wetzel, Robert. J.	n
White, Christopher B.	n
White, Erik	3b – Thompson Surgical Instruments
Whiting, Daniel R.	n
Wild, Christopher	n
Wilke, Benjamin K.	n
Wilkening, Matthew W.	n
Wilkinson, John T.	n
Willey, Michael C.	n
Williams, Benjamin R.	n
Williams, Gerald R., Jr.	1 – DJ Orthopaedics, IMDS; 1, 5 – DePuy, a Johnson & Johnson Company; 4 – CrossCurrent Business Analytics, Force Therapeutics, ForMD, In Vivo Therapeutics, OBERD; 5 – Synthasome, Tornier; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Williams, Riley J., III	1 – Arthrex, Inc.; 3c – Aperion, Inc.; 3c, 4 – R2T2 Laboratories, Inc.; 4 – Cymedica, Inc.; 5 – Histogenics, Inc., Zimmer; 7 - Springer
Willis, Chad	n
Willits, Rebecca Kuntz	3b – Bioelectrics; 4 – GE Healthcare, Novartis
Winn, Wesley	n
Winston, Travis	n
Witte, Dexter	n
Wodowski, Andrew J.	n
Wolf, Brian R.	3b – CONMED Linvatec; 5 – OREF; 6 – Arthrex, Inc.
Woodward, Nicholas W.	n
Wooldridge, Adam	n
Worden, Andrew	n
Wright, Erik	n
Wu, Karen	n
Wyles, Cody C.	n
Wynberg, Jason B.	n
Wyrick, Theresa O.	n
Xiao, Roy	n
Xiong, Ao	n
Yaszemski, Michael J.	3b – K2M, Inc., Medtronic
Yenna, Zachary	n
Yong, Daniel	n
Yonz, Michael C.	n
Yoon, Patrick	3b – Arthrex, Inc., Orthofix, Inc.
Young, Adam C.	n
Young, Ernest Y.	n
Yu, Anthony L.	n
Yu, Elizabeth	n
Yu, Stephen	n
Yuan, Brandon J.	n
Zadzilka, Jayson D.	n
Ziemba-Davis, Mary	n
Ziran, Navid	n
Zisman, Gilat	n
Zlowodzki, Michael P.	n

Zuckerman, Joseph D.	1 – Exactech, Inc.; 3b – Musculoskeletal Transplant Foundation; 3c – Gold Humanism Foundation, J3 Personica/Residency Select; 4 – AposTherapy, Inc., Hip Innovation Technology