



39th ANNUAL MEETING
April 6 – 10, 2022
La Cantera Resort | San Antonio, Texas

2022 PODIUM & POSTER ABSTRACTS

*Denotes presenter

Thursday, April 7, 2022

- First Plenary Session
- Breakout Session #1 | Hand & Elbow
- Breakout Session #2 | Sports Medicine
- Breakout Session #3 | Trauma
- Breakout Session #4 | Hip and Knee Arthroplasty Complications and Infections
- Breakout Session #5 | Tumor/Education/Practice Management

Friday, April 8, 2022

- Second Plenary Session
- Breakout Session #6 | Foot & Ankle
- Breakout Session #7 | Sports/Shoulder/Elbow
- Breakout Session #8 | Trauma
- Breakout Session #9 | Opioid Management
- Breakout Session #10 | Hip Preservation and Arthroscopy

Saturday, April 9, 2022

- Breakout Session #11 | Hip Arthroplasty
- Breakout Session #12 | Pediatrics/Spine
- Breakout Session #13 | Knee Arthroplasty
- Breakout Session #14 | Shoulder Arthroplasty
- Breakout Session #15 | Sports Medicine

POSTERS 1 – 63

POSTERS 64 – 119

Disclosure Information

Paper 1

Preliminary Outcomes of the Femoral Neck System: Equivalent Outcomes at 3 months to a Matched Cohort of Cannulated Screws

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INTRODUCTION: Implant choice for fixation of femoral neck fractures continues to be controversial. The Femoral Neck System has the purposed advantage of angular stability of a sliding hip screw with added rotational stability via an “anti-rotation screw”. In June 2019, the FNS was first used at our institution and this series is a report on preliminary outcomes and reoperation rates.

METHODS: From June 2019 to February 2021, 30 patients with femoral neck fractures were treated with the FNS at our institution. These cases were retrospectively reviewed for preoperative comorbidities, perioperative complications, and post-discharge complications/outcomes at three months postoperatively. These patients were randomly matched 2:1 by age, sex, and BMI to patients with femoral neck fractures treated our institution from 2000-2017 with 3 cannulated screws.

RESULTS: Of the 30 patients included, 20 (67%) were female with a mean age of 67 years and a mean BMI of 25 kg/m². Most (90%, n = 27) fractures were nondisplaced or valgus impacted and 10% (n = 3) were displaced fractures in patients under the age of 50. The mean length of stay was 4 nights with a mean decrease in hemoglobin of 1.4 g/dl and a postoperative transfusion rate of 13%. The complication rate was 20% (n = 6). Complications included avascular necrosis (n = 3), nonunion (n = 1), osteoarthritis (n = 1) and subtrochanteric femur fracture (n = 1). There were no wound healing issues, deep infections, or prominent implants. Three patients (10%) underwent repeat surgery. There was one revision bone grafting of the femoral neck, one conversion to total hip arthroplasty, and one conversion to intramedullary nail for subtrochanteric fracture. The complication and reoperation rates were compared to the matched cohort of patients treated with cannulated screws. The complication rate was 15% (n = 9) compared to 20% for the FNS cohort (OR = 1.42, 95% CI 0.45-4.44 p = 0.6). The reoperation rate was 10% in both cohorts.

DISCUSSION: Our results indicated that at three months, patients treated with an FNS for femoral neck fracture have similar rates of complication and reoperation to a matched cohort of patients treated with cannulated screws. These results, in addition to the development of a single peri-implant subtrochanteric femur fracture, deserves further investigation with biomechanical studies, longer term follow-up, and evaluation of patient reported outcome measures.

Paper 2

Postoperative Bracing After Medial Patellofemoral Ligament Reconstruction

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BACKGROUND: Patellar subluxation and dislocation are common knee injuries among young athletes. Medial patellofemoral ligament reconstruction (MPFLr) is indicated in patients with recurrent patellofemoral instability events who fail nonoperative treatment and demonstrate MPFL injury. Postoperative rehabilitation following MPFLr varies and may include bracing, range of motion, and weightbearing restrictions. The aim of the study was to compare the outcomes of patients who underwent isolated MPFLr who were braced and unbraced postoperatively. We hypothesized both braced and unbraced patients would have similar short-term outcomes.

METHODS: Patients who underwent isolated MPFLr from January 2015 to September 2020 at a single institution were identified. Braced patients wore a hinged-knee brace postoperatively until return of quadriceps function (Brace, "B"; No Brace, "NB"). Patient demographics, functional outcomes, postoperative instability, and reoperations were investigated. Univariate analysis and logistic regression were used to compare outcomes (statistical significance, $p < 0.05$).

RESULTS: Overall, 229 isolated MPFLr were included (B: 165 knees, 146 patients; NB: 64 knees, 58 patients). Baseline demographics were similar (all $p > 0.05$). Median time to straight leg raise (SLR) without lag was shorter in the unbraced group (41 days [IQR, 20-47] vs. 44 days [IQR, 35.5-88.3], $p = 0.01$), while return to sport times were equivalent (B 155 days [IQR, 127.3-193.8] vs. NB 145 days [IQR, 124-162], $p = 0.31$). Recurrent instability rates were not significantly different, but the rate of reoperation for any reason was higher in braced patients (20 knees [12.1%] vs. 0 [0%], $p = 0.001$). Regression analysis identified female gender (OR 2.79, 95% CI 1.01-7.34, $p = 0.049$) and reoperation (OR 19.63, 95% CI 1.43-269.40, $p = 0.026$) were associated with brace use.

CONCLUSION: Patients who were not braced after MPFLr required significantly fewer reoperations and did not experience more recurrent instability events or short-term postoperative morbidity than braced patients. Unbraced patients had significantly decreased time to SLR, and cleared to return to sport at a similar rate and time. Reoperation rates were significantly higher in braced patients. Future studies are needed to identify those who benefit from bracing after MPFLr.

Paper 3

Burnout and EMR Dissatisfaction Predicts Long-term Depression and Anxiety Scores in Orthopaedic Physicians

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BACKGROUND: There is a growing interest in the effects of orthopedic intervention on physical well-being and mental health, and, relatedly, how electronic medical records (EMR) compliance may diminish opportunities for more direct patient-physician communication. Not only can disruptions in patient-physician communication have a lasting effect on patient care and outcomes, it can also impact levels of physician stress and job satisfaction. Indeed, mental health problems, including depressive and anxiety disorders, suicidal ideation, addiction, and burnout are highly prevalent among physicians. Those predisposed to develop symptoms of depression, anxiety, and burnout might be particularly vulnerable to environmental stressors, such as those associated with the pressures of balancing patient-care and administrative responsibilities. Here we investigate whether EMR burden and satisfaction are associated with depression and burnout in orthopedic physicians.

METHODS: 26 orthopedic physicians were followed longitudinally using a passive smartphone sensing application that assessed physical activity and delivered brief weekly surveys of mood and burnout.

RESULTS: Results revealed a relationship between the amount of time physicians spent conducting EMR and self-reported levels of depression ($R = 0.46$, $p = 0.02$). We also observed a relationship between EMR satisfaction and burnout and depression. Specifically, lower satisfaction scores with EMR were associated with higher levels of burnout ($R = 0.6$, $p < 0.005$) and depression ($R = 0.52$, $p < 0.01$). A similar effect was observed for trait measures of anxiety, such that more anxious physicians reported lower levels of satisfaction with their EMR requirements. Of particular interest to the current study, EMR satisfaction, burnout, and depression demonstrate a real-world relationship with physicians' physical activity (collected passively from physicians' smartphones over the course of the year). Put simply, the more physicians were dissatisfied with EMR the less active they were ($R = 0.6$, $p = 0.001$). Similarly, higher levels of burnout and depression predicted lower levels of physical activity (burnout: $R = -0.53$, $p = 0.005$; depression: $R = -0.71$, $p < 0.0001$).

CONCLUSION: Collectively, these results highlight a potential causal relationship between EMR satisfaction, physician burnout, depression, and anxiety. Future research may further delineate whether differences in burnout, depression, and anxiety can be attributed to differences in EMR strategies adopted by physicians (e.g., exam room documentation vs. post-exam dictation with templates).

Paper 4

Outcomes of Distal Femur Fractures Using Nail/Plate Combination

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PURPOSE: Distal femur fractures (OTA class 33A/B/C) account for 1% of all orthopedic fractures and a 13.4% mortality rate in the geriatric population. Surgical fixation options include plating, intramedullary nail, and nail-plate combination fixation. The purpose of this study is to demonstrate the nail-plate fixation technique is associated with a shorter hospital stay, shorter skilled nursing facility stay, shorter time to weightbearing, and no increase in mortality or morbidity compared to conventional plating.

METHODS: A retrospective chart review identified patients with a distal femur fracture (OTA class 33A/B/C) that underwent fixation by one of the two surgeon authors. Patients were included if they received plate, intramedullary nail, or nail-plate fixation and had minimum 180 days of follow up. A generalized linear model compared the significance of fixation type while controlling for comorbidities. Outliers were controlled by log transform in regards to time-to-event data. The occurrence of various comorbidities and adverse events were examined using logistic regression. Time to weightbearing status was analyzed using contrasts to specifically compare plate, intramedullary nail or nail-plate fixation cases. Mortality was assessed using the generalized linear model.

RESULTS: Forty-seven subjects were identified retrospectively by electronic record review. Thirty-three patients remained after excluding for age, incarceration, or non-ambulatory status prior to injury. The mean age was 69.8 years, with 3 males and 30 females. The most impactful factors were fixation type, obesity (BMI>30), and age. There were 7 nails, 11 plates, and 15 nail-plate fixations. When comparing nail-plate fixation to others, there was no significant increase in mortality at 30/60/90/180 days, return trips to the OR, hardware failure, or surgical site infections. Radiographic union trended toward significance ($p = .052$). The nail-plate fixation demonstrated significantly ($p < 0.001$) shorter time to start of WB and full WB ($p < 0.0002$). While not significant ($p = 0.17$), the mean duration of skilled nursing stay was notably shorter with nail plating having 43 days vs. plating at 74 days.

CONCLUSION: The nail-plate technique resulted in a significantly shorter time to start and full weight bearing and does not increase mortality or morbidity when compared with the plate fixation. Additionally, patients who received nail-plate fixation were found to have a shorter skilled nursing stay. Nail-plate fixation strategy is a safe and effective method of fixation for distal femur fractures that could allow patients to achieve full weightbearing status sooner and reduce their length of skilled nursing stay.

Paper 5

Operative Treatment of Distal Radius Fractures in Patients with Parkinson's Disease

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BACKGROUND: Owing to the many unique disease characteristics of Parkinson's Disease - namely resting tremors, muscular rigidity, and poor bone quality - we hypothesized that this patient population would have inferior outcomes with surgical management of acute distal radius fractures compared to the literature available on the general population.

METHODS: This is a retrospective observational study performed at a single, Level 1, academic center from 2001 to 2020 capturing all adult patients with an isolated, acute, and closed distal radius fracture that ultimately underwent operative treatment. International Classification of Diseases (ICD) 10 codes were used to identify 30 patients for manual chart review. Several patient and fracture characteristics were accounted for and complications, reoperations, and failures of surgical intervention were recorded.

RESULTS: There were a total of 7/30 failures (23%), 6/30 reoperations (20%), and 12 complications in 9/30 wrists (complication rate, 30%) at a mean latest follow-up of 11 months (1.2 -158 months). Of the 7 failures, 5 were due to loss of reduction and 2 of them were deep infections with mean time to failure of 8.3 weeks (range, 11 days-5.2 months).

CONCLUSION: The present study found a high rate of complications, reoperations, and early failure despite a short follow-up period and a small cohort of PD patients treated surgically for a DRF. We recommend locked plating, if suitable for the fracture type, and early involvement of a multidisciplinary team to assist with medical optimization of PD in order to increase chances of a successful outcome.

Paper 6

Six-Week Radiographic Follow-Up Does Not Change Management for Nonoperatively Treated Extra-Articular Metacarpal Shaft Fractures

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BACKGROUND: Metacarpal shaft fractures are a common presentation to both the emergency department and orthopedic office. Current recommendations for nonoperative management of extra-articular, closed metacarpal shaft fractures are based on the degree of sagittal plane angulation, amount of shortening, and presence of malrotation. Barring any indication for operative management, extra-articular metacarpal shaft fractures can be treated successfully by nonoperative means. This study wanted to determine how much shortening and change in angulation occurs to fractures that do not meet operative indications on presentation.

METHODS: ICD-10 and CPT codes were used to enroll patients that presented to one institution's orthopedic offices between 2015 and 2019. Radiographs were used to measure lateral angulation and shortening. Paired t test was performed to determine if any statistically significant changes in angulation or shortening occurred over a six-week period. Chart review was used to determine if any changes in management occurred over the duration of follow-up.

RESULTS: A total of 31 patients with 37 metacarpal fractures met inclusion criteria. 84% were treated in a splint and 16% were treated in a cast. The majority (86%) were converted to a removable wrist splint at their two-week appointment. There were significant changes in angulation (2.4 degrees, $p = .0005$) and shortening (0.1 mm, $p = .0386$) over six weeks. No fracture became malrotated over time. No patient was changed from nonoperative to operative management.

DISCUSSION: No clinically significant changes in angulation or shortening occurred over a six-week period and there were no changes in clinical management. Since prior studies have demonstrated that these fractures reliably go on to union, extra-articular metacarpal shaft fractures that do not meet operative indications should be expected to heal with minimal change in angulation and shortening. Follow-up at two weeks to convert the patient to a removable wrist splint appears to be sufficient treatment for these fractures.

Paper 7

Is it Safe to Immediately Mobilize Ulnar Shaft Fractures after Fixation?

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INTRODUCTION: Pronosupination about the forearm is a complex interplay between the carpus, radius, ulna, and interosseous membrane. Previous cadaveric studies have shown that the interosseous membrane functions more as a longitudinal stabilizer rather than for rotational stability during pronosupination. However, many surgeons advocate for above-elbow immobilization after plating of the ulna in order to prevent forearm rotation. The aim of this study was to identify the amount of motion at the site of an ulnar fracture during pronosupination.

MATERIALS & METHODS: A sample of convenience of 7 paired-matched cadavers were used for this study. The arm was positioned and a force was applied to move the forearm through 10 cycles of pronation and supination. A Hall effect sensor was used to monitor micromotion at the fracture. Four conditions were tested: intact ulnar shaft with plate, fracture without stabilization, fracture with cortical apposition stabilized with plate, and a comminuted fracture stabilized with plate. The amount of displacement was recorded in millimeters, and a repeated measures ANOVA with Tukey HSD post hoc analysis with $\alpha = 0.05$ was used to compare the differences between the conditions tested.

RESULTS: There was increased micromotion at the fracture site in the comminuted fracture compared to both the intact and the plated fractures, however, this was not statistically significant.

CONCLUSION: Prior to this investigation, little was known regarding energy transmission from the radius across the interosseous membrane to the ulna during pronosupination. This study showed that plated ulnar fractures, even with comminution, have a comparable amount of motion between the ends of the bone as an intact ulnar shaft during pronosupination. This information may help guide clinicians regarding their postoperative protocols moving forward.

Paper 9

Outcomes of Lunate Fixation vs. Proximal Row Carpectomy for Lichtman Stage IIIC Lunate in Kienböck's Disease

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INTRODUCTION: The treatment of a Lichtman Stage IIIC lunate (coronally oriented fracture) Kienböck's patients is controversial. Traditional teaching was to proceed with a salvage procedure such as a proximal row carpectomy (PRC), but more recently there has been evidence to suggest that these fractures may be treated with screw fixation or vascularized bone graft (VBG). To our knowledge, no comparative studies exist. The purpose of this study was to examine the reoperation rates and functional outcomes between these two groups.

MATERIALS & METHODS: A retrospective chart review was performed for all patients with coronal plane fractures of the lunate in Kienböck's disease at a single institution (2003-2020). Patients who initially underwent a lunate fixation procedure (i.e. open reduction internal fixation, VBG) (n = 21) or PRC (n = 14) were included in this study. The primary outcome examined was reoperation rate, and secondary outcomes included pain, grip strength, and Mayo Wrist Score (MWS).

RESULTS: There was a higher rate of reoperation in patients who underwent a lunate fixation procedure compared to those who underwent PRC (p = 0.028). Of the 21 patients who underwent a lunate fixation procedure, 6 required reoperations. Average time to reoperation was nine months. There were no patients in the PRC group who required reoperation. There were no significant differences in the postoperative VAS pain scores, gain in grip strength, or change in MWS between the lunate fixation and PRC cohorts. The patients who required reoperation were excluded from outcome analysis.

CONCLUSIONS: This study showed that there is a significantly higher reoperation in patients who initially undergo a lunate fixation procedure compared to PRC. Overall, functional outcomes are similar between patients who undergo primary PRC and lunate fixation for coronal plane fractures in Kienböck's disease.

Paper 10

National Benchmarks for the Efficacy of Trigger Finger and the Risk Factors Associated with Failure

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BACKGROUND: Corticosteroid injections and tendon sheath incisions are common procedures in patients with stenosing tenosynovitis. The purpose of this study is to compare the efficacy of single and multiple corticosteroid injections used for symptomatic trigger finger. The rates of subsequent injections and the rate of tendon sheath release are reported as well as the identification of risk factors correlated with failure of injection.

METHODS: A national healthcare database review was conducted identifying patients between 2014 and 2019 with a diagnosis of trigger finger or trigger thumb. Patients were stratified based on treatments received including no treatment, injection(s), and sheath release. Patient cohorts were further stratified based on treatment success as assessed by the need for additional injection within six months or tendon sheath release within one year of initial treatment. Treatment success was recorded when no additional treatment was needed beyond the initial treatment. Further analysis was conducted to assess risk factors for failure of injection management.

RESULTS: 31,751 patients met inclusion criteria and underwent an initial injection within the study period. The efficacy of initial, second, and third injection was 66.3%, 79.4%, and 79.6% respectively. Of the patients that failed a primary injection, 9.4% went on to tendon sheath release and 90.6% sustained a subsequent injection. Of the patients that failed a second injection, 23.1% had tendon sheath release and 76.9% received a subsequent injection. Of the patients that failed a third injection, 30.4% underwent tendon sheath release and 69.6% obtained a subsequent injection. Only obesity (OR 1.2; $P < 0.0001$) and concomitant diagnosis of carpal tunnel syndrome (OR 1.4; $P < 0.0001$) were found to be significant for injection failure on multivariate logistic regression analysis.

CONCLUSION: Overall corticosteroid injections were effective in greater than 65% of patients. This information may help guide treatment practice as there appears to be continued additional benefit to repeat corticosteroid injections following injection failure. Patients with obesity and carpal tunnel should be counselled appropriately for their slightly increased risk of injection failure.

Paper 11

Patient-Reported Outcomes Following Arthroscopic Trapeziectomy with Suture Button Suspensionplasty Vs. Open Trapeziectomy with Ligament Reconstruction and Tendon Interposition for First Carpometacarpal Joint Arthritis

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PURPOSE: This prospective study compares the patient-reported outcomes of arthroscopic trapeziectomy and suture button suspensionplasty (ATSBS) vs. ligament reconstruction tendon interposition (LRTI) in the treatment of first carpometacarpal arthritis of the thumb.

METHODS: Over a two-year period 36 consecutive patients (17 ATSBS and 19 LRTI patients) underwent operative treatment for painful first carpometacarpal thumb arthritis. Patients completed DASH questionnaires and VAS pain scales preoperatively and at 2 weeks, 6 weeks, 3 months, 6 months, and an average of 4.2 years postoperatively. Collected data was used to determine differences in functional recovery and pain between ATSBS and LRTI procedures.

RESULTS: There were no significant differences in ATSBS and LRTI DASH scores before the 3 months postoperative mark. There was a statistically significant difference in DASH scores at 3 months following each procedure and beyond. There were no significant differences in VAS scores for the duration of the study period.

CONCLUSIONS: Patient-reported postoperative functional outcomes with ATSBS and LRTI are similar in the short-term (prior to 3 months), but ATSBS appears to provide better longer-term outcomes. Patients experience similar pain postoperatively with both procedures.

TYPE OF STUDY/LEVEL OF EVIDENCE: Level II - Therapeutic

Breakout Session #1 (Hand/Elbow)
Thursday, April 07, 2022

Paper 12

Leadership Trends In Hand Surgery Fellowships

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PURPOSE: This study's purpose is to characterize the demographic profile and educational backgrounds of current fellowship directors (FDs). A secondary aim is to identify patterns in employment duration, research productivity, training institutions, and professional hand surgery society leadership.

METHODS: Domestic programs and current FDs were identified using the American Society for Surgery of the Hand fellowship directory. Data were collected via internet searches of publicly available information and direct program contact. Variables included demographics (age, sex, race/ethnicity), education and employment history, Hirsch index (H-index) research productivity, and membership of select hand surgery societies.

RESULTS: Information about 86 fellowship directors was collected from a total of 88 identified hand surgery fellowships. 76 (88.37%) were men while 10 (11.63%) were women. Mean age was 53.29. The majority of FDs (n = 68, 79.07%) completed orthopedic surgery residency. Average Scopus H-index was 16.34. The majority of FDs were white (n = 64, 74%) followed by Asian (n = 14, 16%). Mean duration from fellowship completion to FD appointment was 12.39 years while mean duration of employment at an institution prior to FD appointment was 17.74 years. Mean duration of tenure as FD was 9.74 years. 28 (32.94%) individuals serve as FD at their residency institution, 20 (23.53%) lead at their fellowship institution, and 9 (10.59%) attended residency and fellowship at the same institution at which they serve as FD. The most frequently attended residency and fellowship institutions were University of Pennsylvania and Mayo Clinic, respectively. Six FDs have served as president of a national hand surgery society.

CONCLUSIONS: Research productivity is a strength for many FDs. Certain residencies and fellowships produce a disproportionate number of future FDs, creating a 'pipeline effect.' The majority of hand surgery FDs completed residency in orthopedic surgery, and the average time from fellowship completion to becoming a hand surgery FD was longer than in other orthopedic subspecialties. As in other orthopedic subspecialties, FDs are most commonly white and men though female representation is higher than in other subspecialties. Societal leadership roles are relatively uncommon.

TYPE OF STUDY: Level III

Paper 13

Coronal Plane Fractures of the Lunate in Kienbock Disease: Do They Heal?

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HYPOTHESIS: The purpose of this study was to assess the union rate, functional outcomes, and reoperation rate of Lichtman IIIC Lunate Coronal Plane Fractures in Kienbock Disease treated with surgical fixation.

MATERIALS & METHODS: An IRB approved retrospective review of 64 patients with Lichtman Grade IIIC (lunate fractures) Kienbock disease were analyzed. Of these, 21 patients who underwent procedures to fix the lunate were reviewed. Mayo Wrist Score, preoperative and postoperative visual analog scale (VAS) pain, range of motion, and grip strength were analyzed. Radiographs and CT scans were reviewed for Lichtman stage, coronal plane fracture location (volar 1/3, central 1/3, dorsal 1/3), lunate union, modified carpal height ratio, Stahl index, and radioscapoid angle. Fifteen patients with preoperative and postoperative CT scans were included in the union analysis.

RESULTS: Mean clinical follow-up was 16 months. X-ray and CT scan follow-up were 72.5 and 13.5 months, respectively. 10 patients underwent vascularized bone grafting (VBG), 8 had joint offloading procedures without internal fixation of the lunate, and 3 underwent open reduction internal fixation (ORIF) the fracture, with or without concomitant joint offloading and bone grafting. Patients who had a VBG had a union rate of 22%, none healed within the offloading cohort, and there was a 67% union rate in those who underwent ORIF. In terms of reoperation, there were 3 in the VBG, 2 within the offloading group, and 1 within the ORIF group. VAS Pain and grip strength improved postoperatively in the entire cohort from 6 to 3 and 14 kg to 28 kg, respectively. Postoperative Mayo Wrist Scores were highest in the vascularized grafts (64) and ORIF groups (58) compared with the offloading procedures alone (45).

SUMMARY: Overall union rate was higher for those that underwent open reduction and internal fixation with or without offloading procedures and bone grafting at 67%. Reoperation rate was relatively low at 29% despite the 73% overall nonunion rate Vascularized graft, offloading, and ORIF had a 30%, 25% and 33% reoperation rate, respectively overall, coronal plane fractures of the lunate in Kienbock disease have a poor ability to heal regardless of treatment.

Paper 15

Unique Indications for Internal Joint Stabilizer (IJS) for Elbow Instability

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PURPOSE: The objective of this study was to evaluate obesity, advanced age or frailty, and cognitive dysfunction (due to mental handicap, stroke, or traumatic brain injury) as unique indications for the use of the internal joint stabilizer (IJS) in the treatment of elbow instability.

METHODS: This was a retrospective review of all patients 18 years and older with elbow instability who were managed with an IJS along with standard measures of care for their specific injury (such as fracture fixation or collateral ligament reconstruction). Patients were excluded if they did not have a minimum follow-up of 3 months. All patients were treated by a single shoulder and elbow fellowship-trained orthopedic traumatologist at an urban university-based Level 1 trauma center.

RESULTS: Twenty-six patients were reviewed. Four were excluded for inadequate follow-up, leaving 22 patients in the study. Three patients were 60 years of age and older. Eight patients had a BMI of 30 or greater. Five patients had a history of one or more cerebral insults at the time of elbow injury. At final follow-up, patients had an average arc of motion of 17°-114° in the flexion-extension plane and an average pronation and supination of 68° and 66°, respectively. Complications included recurrent elbow instability (n = 1), IJS failure without recurrent instability (n = 1), and infection (n = 2). Five patients did not undergo removal of the IJS. Four of these patients had healed, but were lost to follow-up before IJS removal.

CONCLUSION: The IJS may be used to create elbow stability in complex patients, regardless of weight, frailty, or cerebrovascular insult. In comparison to the literature, external fixation for elbow instability has a much higher risk of infection and is more challenging for patients to take care of due to the weight and bulk of the external fixation frame. When considering internal or external fixation for elbow instability, the IJS may be preferable for the frail elderly, morbidly obese, or cognitively impaired.

Paper 16

Association between Social Media Activity and Patient Ratings in Shoulder and Elbow Surgeons: How Many 'Likes' for Five Stars?

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Vani J. Sabesan, M.D. / Boca Raton, FL
Feyikemi Ogunfuwa, B.S. / Boca Raton, FL
William J. Pallisery, B.S. / Boca Raton, FL
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INTRODUCTION: Social media has expanded its role into healthcare, particularly in aiding patients to select a physician. The use of social media within healthcare is correlated with greater number and improved online patient reviews, and an increase financial return on investment. Although highly regarded amongst the community, specialist surgeons such as shoulder and elbow surgeons, tend to use social media less than other medical professionals. The purpose of this study is to examine social media usage among shoulder and elbow surgeons, and to determine which factors of social media correlate to improved online ratings.

METHODS: The ASES 'Find a Physician' tool was used to identify 130 currently practicing shoulder and elbow surgeons in the Mid-America region. Surgeon ratings and reviews were compiled from Google reviews, Healthgrades, and Vitals. Google search of the physician's name and degree (MD or DO) identified physicians' public Facebook, Twitter, and Instagram accounts in the top ten search results, as well as surgeon demographics. Surgeons' social media platforms were further examined for content type.

RESULTS: This cohort included 125 males and 5 females. Of these, 25 (18.79%) had at least one social media profile (Social Media group SMG), and only 2 physicians had more than one profile. The average age of physicians who used social media was 43.6 years which was consistent with the average age of all physicians (43.6). Physicians in SMG and physicians without both had more than 50 ratings/reviews total and the groups had similar ratings on three physician review websites with no significant differences in scores. The most common content posted was combined text and media, and the most commonly used social media sites were Facebook and Twitter, while only 2.59% of physicians used Instagram.

DISCUSSION: Our results highlight the low rate of social media use among currently practicing shoulder and elbow surgeons in the Mid-America region. Contrary to previous evidence for other specialties, the presence of social media amongst these orthopedic surgeons did not increase the number or value of ratings on physician review websites. Further research on social media activity and volume, such as posting frequency, usage of mixed media postings, and inclusion of personal content need to be studied to see influence on patient ratings and reviews.

Paper 17

Hip FAI with Low Femoral Version is Strongly Associated with ACL Injury

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BACKGROUND: Recent studies have demonstrated an association between decreased internal rotation of the hip and risk of anterior cruciate ligament (ACL) rupture. Cam morphology and decreased femoral anteversion both influence internal rotation range-of-motion of the hip.

PURPOSE: To investigate hip and femur morphology in FAI patients who have a history of ACL reconstruction (ACLR).

METHODS: A retrospective review of 505 patients who previously underwent hip arthroscopy for FAI between June 2017 and February 2021 at a single institution was performed. All patients received preoperative lower extremity CT scans to evaluate femoral version. Patients who had undergone ACL surgery were identified by CT scan and chart review. Patients with previous ipsilateral and contralateral ACLR were included. Three groups were established to classify those with morphology according to parameters associated with decreased hip internal rotation. Preoperative Dunn-lateral x-rays were used to measure alpha angle on the operative side. Patients were matched 1:2 for age \pm 3 years and gender. Measurements were compared with t-tests and chi-square tests with significance level set to $p = 0.05$.

RESULTS: Twelve patients (2.4%) had underwent previous ACLR at the time of hip arthroscopy (5 males, 42%). The mean age was 28.2 ± 9.3 years. Eight patients (67%) had ipsilateral ACLR. The mean AA was significantly greater in patients with previous ACLR ($72.6 \pm 14.6^\circ$ vs. $61.4 \pm 10.8^\circ$, $p = 0.03$). The mean FV was lower in patients with previous ACLR ($12.1 \pm 12.1^\circ$ vs. $17.0 \pm 14.3^\circ$), but this did not reach statistical significance ($p = 0.29$). In total, 10 of 12 patients (83%) with history of ACLR were classified as having parameters associated with decreased hip internal rotation compared to 6 patients (25%) in the matched control group ($p < 0.001$).

DISCUSSION: There appears to be a strong correlation between FAI and ACL injury in athletes with low femoral version with large cam lesions. Future prospective study is warranted.

Paper 18

MPFL Repair has a Higher Failure Rate at Long-term Follow-up compared to MPFL Reconstruction for Recurrent Patellar Instability

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BACKGROUND: The medial patellofemoral ligament (MPFL) is the primary soft tissue restraint to lateral patellar translation and is often disrupted with a lateral patellar dislocation. Surgical management for recurrent patellar instability focuses on restoring MPFL function with repair or reconstruction techniques. Recent studies have favored reconstruction over repair, but no long-term, comparative studies are available in the literature.

METHODS: A total of 55 patients (58 knees) with recurrent lateral instability were treated between 2005 and 2012 with either MPFL repair or MPFL reconstruction. Exclusion criteria included prior or concomitant tibial tubercle osteotomy or trochleoplasty, and follow-up less than 8 years. Pre- and postoperative demographic, surgical, imaging, and clinical data were recorded for each patient.

RESULTS: MPFL repair was performed on 26 patients (29 knees; 14 females, 15 males) at a mean age of 19.1 years. MPFL reconstruction was performed on 29 patients (29 knees; 18 females, 11 males) at a mean age of 18.2 years. Mean follow-up was 12.0 years (range 8.3-18.9). The reconstruction group had a significantly lower rate of recurrent dislocation compared to the repair group (14% vs. 41%, $p = 0.019$) at final follow-up. There were no differences in the number of preoperative dislocations (greater than or less than 3), degree of patellar facet chondromalacia, TT-TG distance, or Tegner scores. The reconstruction group had significantly more time from injury to surgery compared to the repair group (median, 1,460 days vs. 627 days, $p = 0.007$). There were no differences in postoperative Tegner, Lysholm, or Kujala scores at final follow-up. Additionally, there were no differences in return to play rates (repair 80.8% vs. reconstruction 75.0%, $p = 0.610$) or reoperation rates (repair 20.7% vs. reconstruction 13.8%, $p = 0.487$).

CONCLUSION: Repair of the MPFL leads to nearly 3-fold higher rate of recurrent patellar dislocation (41% vs. 14%) at long-term follow-up compared to MPFL reconstruction. However, MPFL repair and reconstruction provide similar clinical results, return to play rates, and reoperation rates.

Paper 19

The Impact of Multiple Prior Dislocations on Outcomes of Isolated Medial Patellofemoral Ligament Reconstruction

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INTRODUCTION: Patellar dislocation is a common knee injury and up to 35% who dislocate will develop recurrent patellar instability. In the setting of recurrent instability, reconstruction of the medial patellofemoral ligament (MPFL) restores knee stability in the majority of patients. Surgical treatment is typically recommended following a second patellar dislocation, but many patients experience multiple dislocations prior proceeding with surgery. Little prior work has explored the relationship between the number of prior patellar dislocations and outcomes following isolated MPFL reconstruction. We hypothesize that patients who have suffered > 2 patellar dislocations prior the MPFL reconstruction will demonstrate poorer patient-reported outcomes following surgery than those who experience ≤ 2 patellar dislocations prior to surgery.

METHODS: Retrospective review identified 200 patients who underwent MPFL reconstruction at an academic medical center between 2008 and 2016. Following exclusion patients who underwent tibial tubercle osteotomy (36) or fixation of an osteochondral fracture (4), 160 patients who underwent isolated MPFL reconstruction were included. Patient demographics (age, sex, body mass index [BMI]), number of prior patellar dislocations, and patient anatomical measures from imaging (Caton-Deschamps index, tibial tubercle-trochlear groove distance, and trochlear sulcus angle) were obtained from chart review. Patients were contacted postoperative and outcomes assessed with Norwich Patellar instability (NPI) score, Knee injury and Osteoarthritis Outcome Score (KOOS), and Marx activity score. Outcomes of those with > 2 patellar dislocations were compared with those with ≤ 2 dislocations using linear regression analysis.

RESULTS: 122 patients (76%) were contacted at a mean of 4.8 years postoperative. Patient reported outcomes forms were completed by 95 patients (60%). 50 patients (41%) 2 or fewer dislocations prior to surgery and 72 patients (40%) had greater than two dislocations. Patients in the > 2 dislocation group were older (27.4 years) than those in the ≤ 2 dislocations group (20.7 years), $p < 0.001$, but no differences were noted between the groups in patient sex, BMI, anatomical measures, or length of follow-up. Controlling for age, sex, BMI, and anatomical factors, patients with > 2 dislocations demonstrated lower KOOS pain (13.7 points, $p = 0.003$), ADLs (8.3 points, $p = 0.025$), sports/rec (18.2 points, $p = 0.009$), and knee related QOL (19.8 points, $p = 0.008$) subscales.

CONCLUSION: Patients who suffer > 2 patellar dislocations prior to MPFL reconstruction demonstrate poorer patient-reported outcomes at 4.5 years postoperative than those who suffer < 2 dislocations prior to surgery.

Paper 20

The Impact of Articular Cartilage Status on Outcomes of Isolated Medial Patellofemoral Ligament Reconstruction

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INTRODUCTION: Patellar instability is characterized by lateral dislocations or subluxations of the patella. In cases of recurrent instability, surgical treatment is preferred, frequently with a reconstruction of the medial patellofemoral ligament (MPFL). Patellar dislocations may also be associated with damage to the articular cartilage of the patella. The impact of articular cartilage damage on outcomes following MPFL reconstruction is not well understood. It was hypothesized that the presence of articular cartilage defects in the patellofemoral joint at the time of MPFL reconstruction is associated with poorer patient-reported outcomes following surgery.

METHODS: Retrospective review identified 200 patients who underwent MPFL reconstruction at an academic medical center between 2008 and 2016. Following exclusion of 36 patients who underwent concomitant tibial tubercle osteotomy and 4 patients who underwent fixation of an osteochondral fracture, 160 patients who underwent isolated MPFL reconstruction were eligible for study inclusion. Patient demographics (age, sex, body mass index [BMI]), patellofemoral articular cartilage status at surgery, and patient anatomical measures from imaging (Caton-Deschamps index, tibial tubercle-trochlear groove distance, and trochlear sulcus angle) were obtained from chart review. Patients were contacted postoperative and outcomes assessed through collection of Norwich Patellar instability (NPI) score, Knee injury and Osteoarthritis Outcome Score (KOOS), and Marx activity score as well as assessment for recurrent dislocation.

RESULTS: 122 patients (76%) were contacted at a mean of 4.8 years postoperative. Patient-reported outcomes forms were completed by 95 patients (60%). 63 patients (52%) had grade 3 or 4 patellofemoral chondral damage at the time of surgery. The majority of the defects were on the medial patella (72%) and the mean patellar defect size was 2.8 cm². The KOOS Knee Related Quality of Life subscale score was significantly lower in the group with significant cartilage damage (57.8 ± 28.3) compared to the group without significant cartilage damage (70.0 ± 28.3), $p = 0.037$). The group with articular cartilage damage was noted to have a modestly higher BMI (27.9 vs. 25.7, $p = 0.04$), but not other differences were noted between the groups.

CONCLUSION: Patients with grade 3 or 4 articular cartilage damage of the patellofemoral joint at the time of MPFL reconstruction demonstrate poorer KOOS knee related quality of life at a mean of 4.8 years following MPFL reconstruction.

Paper 21

Differences in Humeral Torsion Between Right-Handed and Left-Handed Major League Baseball Pitchers.

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Left-handed pitchers (LHPs) have demonstrated inferior throwing metrics, such as velocity, spin rate, and pitch break, compared to right-handed pitchers (RHPs). These observed discrepancies could be rooted in anatomical differences between LHPs and RHPs. High-level pitchers demonstrate significant changes in glenohumeral range of motion compared to the normal population, which is the result of structural adaptations that occur in response to stress placed on the shoulder by the overhead throwing motion. One such adaptation is humeral torsion, which is the twist about the humeral shaft between the humeral head and distal articulating surface. This study seeks to determine if shoulder range of motion measurements and humeral torsion differ between LHPs and RHPs.

217 MLB pitchers from a single organization were evaluated over a 7-year period from 2013-2020. Ultrasound scanning was used to determine neutral position of the shoulder and the degree of humeral torsion was measured with a goniometer. The mean and standard deviations were calculated. Data were assessed for normality using Shapiro-Wilk. Differences between LHPs and RHPs were assessed using one-way ANOVA. Arm effects were assessed using paired samples t-tests. The Holm-Bonferroni adjustment was applied to account for multiple comparisons.

RHPs showed, on average, 13.9 degrees more shoulder external rotation range in their throwing arm compared with their non-throwing arm, whereas LHPs averaged only 2.2 degrees. RHPs showed greater asymmetries in shoulder internal rotation range (13.9 vs. 4.8 degrees, $P = .000$) and humeral torsion (-23.1 vs. -2.2 degrees, $P = .000$). LHPs also showed significant flexion deficits in the throwing shoulder compared to their right-handed counterparts, (7.5 vs. 0.0 degrees, $P = .000$).

RHPs demonstrated significantly greater measures of humeral retrotorsion (negative torsion), external rotation, and shoulder flexion compared to left-handed counterparts. These findings likely contribute to the observed differences in throwing metrics LHPs and RHPs. Consequently, changes in these measurements have been associated with different injury risks and challenges in assessing rehabilitation progress. Clinically, understanding that asymptomatic LHPs may examine differently than RHPs due to underlying anatomical adaptations, can help guide treatment strategies when dealing with specific injuries or implementing a rehabilitation or shoulder maintenance program.

Paper 22

Biologic Augmentation In ACL Reconstruction: What Matters?

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PURPOSE: Biologic augmentation has received much attention in recent research focusing on anterior cruciate ligament reconstruction (ACLR). Controversy exists over the value of biologic augmentation. This study was undertaken to evaluate the effective of biologic augmentation on ACLR.

METHODS: Thirty patients, age 18 or less, undergoing ACLR utilizing autologous hamstrings were enrolled in a prospective, double blind, randomized trial. Fifteen patients had platelet rich plasma (PRP) applied to their graft at the completion of the ACLR. The other fifteen patients had a collagen membrane applied to their graft and PRP was placed inside the membrane. Patients underwent sequential magnet resonance imaging (MRI) 6 weeks, 3 months, and 6 months postoperatively. MRIs were read by a single musculoskeletal radiologist blinded to the procedure. The knee was positioned in a standardized fashion and the MRI was executed in 2-4 mm sections through the notch in oblique, sagittal, coronal and axial planes recording in T1, T2, proton density fat saturation and STIR modalities. MRIs were scrutinized for tunnel enlargement, bony edema, bony ingrowth, graft integrity, and homogeneity of the graft signal.

RESULTS: T2 sequences were shown to exhibit less artifact from magic angle and field inhomogeneity and thought to be the best sequence to show true, consistent, and reproducible signal within the graft from study to study. The reconstructed ACLs were evaluated at the proximal, middle, and distal region. ACLRs performed with PRP and collagen membrane demonstrated a darker and thicker ligament appearing more like a posterior cruciate ligament than those augmented with only PRP. This was felt to be consistent with revascularization and ligamentization. The combination also produced reconstructions more homogeneous in thickness and signal than the radiologist has typically seen in the past with standard ACLRs. MRIs demonstrated no cases of tunnel enlargement on the femoral or tibial sides in either group. Bony edema in the tunnels resolved quicker in the PRP collagen membrane group and bony ingrowth was more complete with the PRP collagen membrane combination.

CONCLUSION: In this preliminary MRI study, biologic augmentation utilizing PRP and a collagen membrane in ACLR demonstrates a more homogeneous graft signal, with quicker resolution of bony edema and more complete bony ingrowth than PRP by itself.

Paper 23

Augmented Immunomodulation of Endogenous Marrow-Derived Stem Cells in the Setting of ACL Rupture

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PURPOSE: Augmentation of MSC immunomodulation is an unexplored, potentially useful therapeutic to combat PTOA following ACLR. Lower kynurenine-to-tryptophan ratios observed in synovial fluid of ACL rupture (ACLR) rats suggests decreased activity of tryptophan metabolizing enzyme, Ido, known to be secreted by MSCs to promote T-reg expansion and Th17 suppression. This study aims to characterize the immunomodulatory capacity of pharmacologically mobilized MSCs in conjunction with exogenously delivered Ido.

METHODS: Rats (N = 48) underwent ACLR to evaluate the effects of mobilized MCSs on Ido1 and inflammatory cytokine expression profiles in the synovial fluid. Additionally, rats (N = 160) underwent ACLR to assess the immunomodulatory influence of therapeutic Ido in vivo via gait analysis parameters known to correlate to pain and inflammation. Gait data was collected longitudinally prior to injury and at 3, 7, 10, and 14 days post-injury.

RESULTS: ACLR induced an increase in inflammatory markers including TNF- α and Fractalkine. Treatment with AMD3100, which induces MSCs recruitment, increased Ido within the injured joint while decreasing inflammatory markers. Gait analysis following ACLR demonstrates that AMD3100 and exogenous Ido exhibited normalizing effects on several gait parameters compared to control.

CONCLUSION: Increased MSC recruitment and exogenous Ido delivery following ACLR may be effective at modulating joint pain and inflammation associated with PTOA.

Paper 24

Compressibility of Osteochondral Autograft Transfer Donor Grafts

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BACKGROUND: Osteochondral Autograft Transfer (OAT) is a useful technique for full-thickness cartilage lesions of the distal femur. Various techniques recommend harvesting a plug 2 mm longer than the recipient hole to allow for graft impaction. Grafts with limited compressibility may not sit flush when impacted. The objective of this study was to compare the compressibility of donor OAT grafts from the distal femur and determine which donor sites provide the most compressibility.

METHODS: Twenty cadaver knees were divided into four donor regions: Medial intercondylar (IC) Notch, Lateral intercondylar (IC) Notch, Medial Trochlea, and Lateral Trochlea. Each region was sub-divided into four zones: far superior (FSZ), middle superior (MSZ), middle inferior (MIZ), and far inferior (FIZ). A total of 320 grafts were extracted using an OATS Kit (Arthrex, Naples, FL) at 6 mm diameter and 15 mm depth. A custom-built machine was used to strike the graft five times using a predetermined force and the graft length was measured in millimeters (mm) initially and after each impaction. Statistical analysis of the compressibility for the 4 regions and all 16 zones was performed utilizing ANOVA with post-hoc testing using Fischer's Least Significant Difference.

RESULTS: The lateral IC notch, medial IC notch, medial trochlea, and lateral trochlea had compression of $2.4 \text{ mm} \pm 1.5$, $2.1 \text{ mm} \pm 0.7$, $3.1 \text{ mm} \pm 2.2$, and $2.1 \text{ mm} \pm 0.6$, respectively. There was a significant difference in compression between the four regions ($p < 0.01$) with the most compression in the medial trochlea region ($p < 0.01$). Subgroup analysis showed no significant difference in compressibility among zones of the medial trochlea region ($p = .37$) and medial IC notch region ($p = .69$). The lateral trochlea region showed higher compressibility for FIZ vs. MIZ ($p = 0.02$). The lateral IC notch region showed higher compressibility for FSZ vs. FIZ and MIZ ($p < .05$).

CONCLUSION: OAT donor grafts show the highest compressibility in the medial trochlea region (3.1 mm) and lateral IC notch FSZ (3.0 mm). Lateral trochlea, medial IC notch, and lateral IC notch MIZ/FIZ grafts should not be oversized more than 2 mm as these grafts may not compress adequately.

Paper 25

ACL Graft Preparation with Vancomycin Has No Effect on Patient Reported Outcomes, Graft Rupture Rates, and Chondrocyte Viability Following Primary ACL Reconstruction

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INTRODUCTION: Intraoperative anterior cruciate ligament (ACL) graft preparation with vancomycin irrigant has been shown to significantly reduce the rate of infection in large cohort studies. However, the effect of vancomycin on patient reported outcomes (PROs) and graft failure in the setting of ACL reconstruction is currently poorly understood. Additionally, previous basic science studies have shown that vancomycin exposed grafts absorb and slowly elute vancomycin for up to 24 hours while the effect of prolonged vancomycin exposure on chondrocyte viability is unknown. The purpose of the current study was to determine the effect of vancomycin on chondrocyte viability and to evaluate 2-year PROs and graft failure stratified by intraoperative vancomycin use.

METHODS: A retrospective review of prospectively collected data was performed on all primary ACL reconstructions performed between 2012-2018 at a single academic institution. Patients completed Rand 36-item Short-form (SF-36), Knee injury and Osteoarthritis Outcome Score (KOOS), and Marx Activity Rating Scale (MARS) instruments preoperatively as well as 6 months and 2 years following ACL reconstruction. Information regarding additional knee injuries or surgeries was collected at time of final recorded follow-up. Revision ACL reconstructions and patients with incomplete PRO data or less than 2-year follow-up were excluded. Cases were stratified based on vancomycin use. Additionally, bovine explant osteochondral plugs were treated with differing concentrations of vancomycin irrigant for 72 hours and stained with calcein to detect viable chondrocytes. Statistical analysis was performed utilizing Student's t-test and chi square analyses as appropriate.

RESULTS: In total, 408 primary ACL reconstructions (210 males; 51.5%) with a mean age of 25.1±10.3 years were included in the study. Intraoperative vancomycin was used in 283 cases (69.3%), while 125 ACL reconstructions (30.6%) were performed without the use of vancomycin. The vancomycin cohort exhibited no difference in SF-36, KOOS, and MARS scores preoperatively as well as at 6 months and 2 years following ACL reconstruction compared to patients who underwent ACL reconstruction without the use of vancomycin. Additionally, there was no difference observed in the rate of ACL graft failure between vancomycin (n = 7; 2.5%) and non-vancomycin (n = 4; 3.2%) treated grafts (p = 0.676). Lastly, vancomycin was determined to not be toxic to chondrocytes at therapeutic doses.

CONCLUSION: Intraoperative graft preparation with vancomycin irrigant has no effect on PROs, graft failure rates, and chondrocyte viability following primary ACL reconstruction.

Paper 26

Limb Occlusion Pressure vs. Standard Pneumatic Tourniquet Pressure in Arthroscopic Assisted Anterior Cruciate Ligament Reconstruction - A Randomized Trial

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BACKGROUND: Tourniquets are used extensively in orthopedic surgery. Complications, while rare, are associated with elevated pressure and duration of occlusion. Limb occlusion pressure (LOP) is the minimum pressure at which arterial blood flow is restricted. The purpose of this study was to compare the use of LOP (assessed in OR) vs. standard tourniquet pressure (STP) with regard to postoperative pain and opioid usage following anterior cruciate ligament reconstruction (ACLR).

METHODS: This investigation was double-blinded randomized control trial. Forty-four patients (Age = 37 ± 15 y) undergoing ACLR were recruited and randomized into STP (275 mmHg; M = 13/F = 14) or LOP (185 \pm 15 mmHg; M = 7/F = 10). Pain at the tourniquet and surgical sites (Visual Analog Scale; VAS 0-10) as well as opioid medication usage (quantified using morphine milligram equivalents; MME) was recorded daily for 14 days post-surgery. Surgeons also recorded intraoperative blood loss and visual field difficulties. A t-test was used to compare group demographics and intra-op measures between groups. A generalized linear mixed-model was used to detect within- and between-group differences in pain and medication use over the 14-days.

RESULTS: No differences were observed between groups for demographics, surgical time, blood loss, or visual field. VAS pain was lower at both the surgery and tourniquet site across the two-week postoperative period in the LOP group with a significant reduction at the surgery site at day 14 and at the tourniquet site at days 1-3 post-surgery. When averaged, tourniquet site pain was also significantly reduced across the first 48h as well as the first week following surgery. MME consumption was reduced during the two-week postoperative period with a significant reduction in the LOP group at day 3 post-surgery. The STP group consumed medication out to 11 days post-surgery compared to the LOP group at 7 days.

CONCLUSIONS: Preliminary results from this investigation indicate that the use of LOP, rather than STP, may contribute to reduced postoperative pain (primarily at the tourniquet site) paralleled by reduced opioid pain medication usage following ACL reconstruction. The use of LOP may provide a cost-effective, non-invasive, and non-pharmaceutical methodology for postoperative pain management.

Breakout Session #2 (Sports Medicine)
Thursday, April 07, 2022

Paper 28

Intrinsic Anthropometric Factors are Associated with Bone Stress Injuries in Collegiate Distance Runners: New Risk Metrics & Screening Tools?

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BACKGROUND: While it is known lower limb bone stress injuries (BSI) of the pelvis, femur, and tibia are common and more prevalent in collegiate track & field distance runners, it is not known the population's bone, body composition (BComp), and anthropometric parameters prior to first respective collegiate injury compared to non-injured counterpart.

PURPOSE: This study aimed to (1) characterize bone mineral density (BMD), BComp, and skeletal dimensions from a total body dual x-ray absorptiometry (DXA) scan in collegiate distance runners prior to lower limb BSI status (i.e. injured or non-injured) to provide indices of risk and (2) develop BMD prediction models.

METHODS: Distance runners ($n = 79$) from a single university track & field team were retrospectively enrolled into this study. Enrolled runners completed a DXA scan (August-November) and participated in sport activities before scan. Three months following scan, electronic medical records were reviewed to determine BSI status. Independent samples t-test was used to compare BMD, BComp, and anthropometric measures between groups. Multiple linear regression with stepwise removal was used to determine measures most predictive of BMD. Type-I set at $\alpha = 0.05$.

RESULTS: Of the 79 enrolled (42 males, 37 female), 18 runners (22.8%; 11 females, 7 male) sustained a lower limb BSI. Compared to non-injured, injured runners had lower total and regional (i.e. spine, pelvis, and legs) BMD ($p < 0.05$) and shorter limb lengths ($p < 0.05$) while injured males had lower fat mass and females lower leg lean mass ($p < 0.05$). Injured runners' age-matched total BMD z-scores (-0.1 ± 0.6) were clinically normal. BComp and anthropometric measures were predictive of total and regional BMD ($P < 0.05$, $R^2 = 0.64-0.80$ g/cm², percent error = 3.8-4.8).

DISCUSSION/CONCLUSIONS: Incidence of BSI is associated with reduced regional BMD in collegiate cross-country runners. However, these measures were not observed to be low relative to general population standards; thus, highlighting the need for normative BMD benchmarks within this sport population. Lower, sex-specific, fat (male), and leg lean (female) tissue may also be indicative of lower limb bone injury risk as well as shorter limb lengths and smaller statures. Body composition, skeletal dimensions, and demographics are predictive of total and regional BMD in this population and may be used as a proxy in the absence of DXA as a novel screening tool to identify lower limb BSI at-risk runners. Finally, these findings can be used in conjunction with dietary screening to enhance lower limb BSI risk assessment within this specialized collegiate sport population.

Paper 29

Malnutrition is Common and Increases the Risk of Adverse Medical Events in Older Adults with Femoral Fragility Fractures

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INTRODUCTION: Malnutrition is a recognized risk factor for postoperative complications and has been well documented in elective procedures, but remains somewhat unexplored in trauma patients. Our purpose was to assess the annual trends of malnutrition and to determine its prevalence in operative femur fractures. Furthermore, to determine risk factors for and complications of malnutrition in patients ≥ 65 years old presenting with femur fracture. We hypothesized that malnutrition would increase the risk of postoperative wound infection, wound dehiscence, nonunion and mortality and that age, gender, and increased Charlson Comorbidity index (CCI) would be risk factors for malnutrition.

METHODS: The Humana Inc. administrative claims database was reviewed from 2015 to 2020. Patients ≥ 65 years old with operative femur fractures were identified by CPT code. A preoperative diagnosis of malnourished state was defined by ICD-10 codes and patients were divided into malnourished and non-malnourished cohorts. Patients were tracked for one year following operative fixation of femur fracture for the occurrence of infection, wound dehiscence, nonunion, and mortality. The rates of these complications were compared between malnourished and non-malnourished cohorts using standard statistical techniques.

RESULTS: There were 79,630 total femur fractures identified. The overall prevalence of malnutrition in femur fractures was 5.68%. Documented malnutrition in femur fractures more than doubled in 2020 compared to 2016, increasing from 2.89% to 8.35% ($P < 0.0001$). The rate of infection was 0.6% in the malnourished cohort and 0.4% in the non-malnourished cohort ($P = 0.07$). Wound dehiscence was 0.11% in the malnourished and 0.04% in the non-malnourished cohort ($P = 0.09$). Nonunion was 0.22% in the malnourished cohort and 0.57% in the non-malnourished cohort ($P = 0.003$). Mortality was 16.4% in the malnourished cohort and 10.4% in the non-malnourished cohort (OR 1.92). There was significantly increased risk for malnutrition in females (OR 1.14) and CCI ($P < 0.0001$).

CONCLUSION: The current study shows malnutrition nearly doubles the odds of mortality with an overall mortality rate of 16.4% compared to non-malnourished elderly patients with femur fractures.

The rates of malnutrition increased steadily from 2016-2020, inferring an increased risk of malnutrition in 2020 compared to 2016. However, this trend is likely a result of increased awareness and testing for malnutrition and may not actually reflect increased rates of malnutrition. Significant risk factors for malnutrition in this study are female gender and CCI. Age was not a significant risk factor.

Paper 30

Anatomic Considerations of Sacroiliac Joint Clamp Reduction Utilizing the Anterior Intrapelvic Approach

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PURPOSE: To delineate the anatomic considerations of clamp assisted reduction of the sacroiliac (SI) joint through the Anterior intrapelvic (AIP) approach. We aim to determine the anatomic relationship of a reduction clamp to the iliac vessels, L5 nerve root, and lumbosacral plexus. The secondary aim is to determine whether screws placed in the sacrum and ilium for clamp attachment endanger the S1 nerve root, interfere with iliosacral screw insertion, or preclude reliable imaging of bony landmarks for safe placement of iliosacral screws.

METHODS: The AIP approach was performed on nine fresh, frozen cadavers according to published surgical technique. The lateral two centimeters of the sacral ala at the level of the pelvic brim was further exposed. Two 3.5mm screws were used to attach a Jungbluth or Farabeuf reduction clamp to the sacral ala and ilium. The pelvis was then dissected to expose the neurovascular structures of interest. Photographs were obtained. Distance measurements from neurovascular structures to the nearest aspect of the clamp were made with ImageJ software (US NIH, Bethesda, MD). Fluoroscopic images of the pelvis and sacrum were obtained to determine clamp - screw position relative to the S1 nerve root tunnel, and to ensure that landmarks for iliosacral screw placement remained visible with the clamps in place.

RESULTS: The clamp was 25.40mm (12.92-36.63, SD 7.02) from the common iliac artery, 8.0mm (2.28-11.14, SD 2.58) from the external iliac artery, and 9.85mm (4.588-21.18, SD 5.85) from the internal iliac artery. The L5 nerve root was 5.5mm (0.62-26.08, SD 6.54) medial to the sacral alar screw. The obturator nerve was most variable; it was located 9.49mm (1.311-30.64, SD 7.36) from the reduction clamp. Obfuscation of bony landmarks occurred most commonly in the outlet view where the S2 corridor was unable to be reliably identified in 50% of specimens. The S1 corridor was obscured in 28% of cases. Jungbluth clamps more commonly precluded identification of S1 on the AP view, and S1 and S2 on the outlet view than the Farabeuf clamp. No damage to neurovascular structures under investigation was observed.

CONCLUSION: Clamp reduction of the sacroiliac joint is feasible via the AIP approach. Surgeons need to be aware of the proximity of screw and clamp placement to major neurovascular structures and the potential for obfuscation of bony landmarks on fluoroscopic imaging necessary for iliosacral screw placement.

Paper 31

Early Simultaneous Intramedullary Nailing vs. Temporizing External Fixation in Multiply Injured Patients with Bilateral Femoral Shaft Fractures

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PURPOSE: We sought to compare the perioperative outcomes and safety of early intramedullary nailing (IMN) vs. external fixation (EF) utilizing the principles of damage control orthopedics in the treatment of bilateral femoral shaft fractures in multiply injured patients.

METHODS: The records of 35 patients who sustained traumatic bilateral femoral shaft fractures treated at an academic, level one trauma center between 2010 and 2020 were retrospectively reviewed. Two cohorts were determined based on initial treatment: bilateral early IMN and bilateral temporizing EF. The latter cohort was definitively treated with IMN. Patients under the age of 18, with fractures of metastatic or bisphosphonate induced etiology, and those undergoing a combination of IMN and EF in the same procedure were excluded. Demographics, injury characteristics, and perioperative outcomes were ascertained via chart review.

RESULTS: Twenty-three patients were found to have been treated initially with EF, while 12 were treated initially with simultaneous IMN. The mean injury severity score for the EF and IMN groups were not significantly different at 23.8 and 17.2, respectively ($p = .06$). American Society of Anesthesiologists scores and age were also not significantly different amongst the cohorts, 2.9 and 36.5 years old in the EF group and 2.8 and 46.4 years old in the IMN ($p = .96$ for ASA and $p = .17$ for age). A significantly shorter length of stay (22.2 days vs. 9.2 $p < .0001$) and lower number of postoperative intensive care unit days (9.4 days vs. 2.2, $p = .03$) was observed in the IMN group, as was a significant reduction in packed red blood cell transfusions (10.5 units vs. 2.9, $p = .01$). One deep vein thrombosis, one death, two incidences of acute respiratory distress syndrome, four incidences of fat emboli syndrome, and three incidences of multiple organ dysfunction syndrome were observed, all of which occurred in the EF cohort.

CONCLUSION: The use of simultaneous IMN as means of early definitive fixation of bilateral femoral shaft fractures in multiply injured patients is a safe and effective practice. We observed that initial IMN was associated with numerically fewer perioperative complications than EF as well as a significantly lower length of stay and total days in the intensive care unit.

Paper 32

Soft Tissue Injury Should Guide Management in Open Fractures of the Femoral Shaft

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PURPOSE: Best available literature suggests that open femur fractures reliably progress to union at rates similar to closed fractures. However, these antiquated findings are limited by significant treatment and selection bias. The aim of this study was to assess the impact of injury severity and patient demographics on infection and reoperation after an open femur fracture treated with modern reamed, statically locked intramedullary nails. We hypothesized that surgical site infection and reoperation after an open femur fracture are more common than previously described, with time to union increased compared to closed fractures.

METHODS: An institutional database was used to identify patients with open subtrochanteric or femoral shaft (AO/OTA 32) fractures from blunt or penetrating trauma with vascular injury who presented to a Level I trauma center between 2012 and 2020. Patients were excluded for incomplete records, lack of one year outcome data, low energy gun-shot related injuries without vascular injury, or traumatic amputation. Union was defined using the modified Radiographic Union Score for Tibial Fractures (mRUST), and deep infection within 90 days was defined using the Fracture-Related infection Consensus Group definition. Medical records were used to collect days to wound coverage, OTA open fracture classification, time to definitive and temporary (if applicable) fixation, time to antibiotics, radiographic mRUST score at all available time points, age, smoking, and diabetes. Cox and multivariable logistic regressions were used to identify significant associations.

RESULTS: A total of 95 patients met exclusion and inclusion criteria. 12% went on to develop a fracture-related infection. Multivariable analysis found a higher OTA skin score (requiring flap/graft coverage or degloving) (AR = 64%, OR = 3.0, $p < 0.001$) and delayed definitive fixation (AR = 32%, OR = 30, $p = .006$) were independently associated with the development of deep infection. Lack of definitive wound coverage within five days was significantly associated with an increased time to union (HR = 0.22/year, $p = 0.036$). Across the entire cohort, the overall reoperation rate was 39%. The median time to radiographic was 6 months after surgery with 21% of patients requiring reoperation for nonunion.

CONCLUSION: Open femur fractures are high energy injuries that have elevated reoperation, infection, and nonunion rates. Delayed definitive fixation and higher degree of skin injury were independently associated with the development of deep infection while wound coverage more than five days after injury was associated with increased time to union. Clinicians should be mindful of both the complication profile and the role soft tissues place in healing of these fractures and plan post-traumatic reconstruction accordingly.

Paper 33

Traumatic Dislocation of the Proximal Tibiofibular Joint: A Systematic Review and 10-year Experience from a Level 1 Trauma Center

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OBJECTIVE: To present a systematic review of traumatic proximal tibiofibular joint dislocations and to compare rates of associated injuries of open fractures, pre- and postoperative peroneal nerve injury, vascular injury, and amputation with a retrospective series of patients at our level 1 trauma center.

METHODS: We conducted a systematic review of MEDLINE to identify 3 total studies meeting eligibility criteria: involving ≥ 3 patients, involving acute proximal tibiofibular joint dislocation (NOT chronic instability), and sustaining injuries via a high-energy, traumatic mechanism. These studies were reviewed for rates of open fracture, vascular injury, pre- or postoperative nerve injury, and amputation. We then performed a retrospective case study of 17 skeletally-mature patients with proximal tibiofibular dislocation treated at our level 1 trauma center from January 1, 2010, to July 6, 2020. Chart review was used to extract patient demographics, fracture patterns (OTA classification), and presence or absence of open fractures, pre- and postoperative peroneal nerve injury, vascular injury, and amputation. Binary logistic regression analysis was utilized to identify clinical predictors of outcomes (Minitab, LLC).

RESULTS: In our series, 16 of 17 (94.1%) proximal tibiofibular injuries were associated with fracture: most common being tibial shaft fractures (11, 68.75%). 12 of 17 (70.6%) fractures were open. Five (29.4%) vascular injuries were sustained requiring a repair or amputation. Seven (41.2%) preoperative peroneal nerve deficits were noted, six of whom had persistent deficits postoperatively or proceeded to amputation (average follow-up 13.5 ± 16.3 months); one patient did have return of nerve function at six months. Two patients in the sample without preoperative peroneal nerve deficits were noted to have a deficit after proximal tibiofibular fixation. Eight patients (47%) received an amputation. Risk of amputation was greater in patients with an open fracture [OR = 4.70 (95% CI 0.12-177.52)] and vascular injury [OR = 7.3062 (95% CI 0.28-188.91)]. Six (35.3%) patients had their proximal tibiofibular hardware removed secondary to loosening or symptomaticity. Complication rates were generally within ranges reported in our systematic review, particularly for open fracture (76.7%), vascular injury (56%), and amputation (33%).

CONCLUSION: Traumatic proximal tibiofibular fractures are a marker of severe injury with high risk for nerve injury and eventual amputation. Patients who present with vascular injury and open fracture in association with proximal tibiofibular joint disruption are at elevated risk of amputation.

Paper 34

Compartmental Syndrome and Neurovascular Injuries in the Setting of Ballistic Fibula Fractures

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OBJECTIVES: It was the authors' purpose to demonstrate whether fibula fractures as a result of a ballistic injury represent a subset of fibula fractures that have a high incidence of compartmental syndrome and associated neurovascular injuries.

DESIGN: Retrospective chart review

PATIENTS: A search of the billing database was performed to identify all fibula fractures. All patients with a gunshot mechanism were selected from a chart review.

RESULTS: There were 39 fractures of the fibula resulting from low velocity ballistic injury. There were 19 proximal third, 15 middle third, and 5 distal third. The group associated with the highest morbidity was the proximal 1/3 group. Fifteen of the 19 patients (79%) with proximal third fractures had an associated neurovascular injury and/or compartmental syndrome. Within this group, 5 of 19 had compartment syndrome (26%); 11 of 19 had neurologic injury (58%); and 5 of 19 had a vascular injury (26%). The middle 1/3 group had 6 of the 15 patients (40%) experience a neurologic injury and/or compartmental syndrome. The distal 1/3 group did not have associated neurovascular injuries or compartmental syndromes.

CONCLUSION: The rate of associated injury with isolated fibula fractures secondary to a ballistic injury is quite high, and has a relationship with the location of the fracture. The more proximal fractures are more likely to have an associated neurovascular injury or an issue with compartmental syndrome. Proximal and middle 1/3 fibula fractures should be admitted for frequent neurovascular checks and possible fasciotomies.

Paper 35

Short Term Complications of Civilian Ballistic Vs. Blunt Distal Intra-Articular Femur Fractures

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BACKGROUND: The purpose of this study was to assess the short-term outcomes of patients with intra-articular distal femur fractures caused by a low energy ballistic injury vs. blunt force trauma.

METHODS: A retrospective review of operatively managed distal femur fractures between 2015 and 2019 was performed. Patients with distal femur fractures that extended into the articular surface were included. Patients with high velocity ballistic injuries, periprosthetic fractures, pathologic fractures, and fractures with lack of extension into the articular surface were excluded. Patient demographics, fracture characteristics, treatment modalities, follow-up, and outcomes were assessed.

RESULTS: One-hundred eleven patients sustained intra-articular distal femur fractures. Of these, 35 (32%) were resultant from blunt trauma while the other 76 (68%) were due to ballistic trauma. Ballistic fractures were significantly more likely to be OTA B-type fractures (71% vs. 46%; $p = 0.01$). Ballistic fractures were also significantly more likely to have follow-up less than 30 days post-injury (46% vs. 20%; $p = 0.0085$). Complications were noted more frequently in blunt fractures (21%) vs. ballistic fractures (8%) ($p = 0.093$), with infection requiring formal irrigation and debridement in two (6%) blunt patients and one (2%) ballistic patient.

CONCLUSION: Patient demographics, injury characteristics, postoperative complications, and follow-up differed significantly between the ballistic and blunt fracture groups. Overall, patients with ballistic fractures had a lower rate of postoperative complication compared to blunt trauma patients.

Paper 36

Templating for Calcaneus Operative Treatment: How Similar are Radiographic Measurements from One Side to the Other?

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INTRODUCTION: Calcaneal fractures are often complex, intra-articular injuries with relatively poor functional and chronic pain outcomes as compared to other fractures. In many cases, the number of fracture fragments and degree of displacement can create challenges for reconstructive purposes, which is why some surgeons will use radiographs of the contralateral, uninjured calcaneus as a template. In this study, we sought to investigate the validity of this pre-templating method by comparing the critical radiographic measurements obtained from contralateral calcanei within the same patients. We hypothesize that there will be no statistically significant differences in the radiographic parameters in terms of laterality, gender, or age.

METHODS: The bilateral foot or calcaneus radiographs of >800 uninjured patients were retrospectively collected and independently reviewed by three observers. Each observer independently measured Böhler's Angle (BA), Critical Angle of Gissane (CAG), calcaneal length (CL), calcaneal height (CH), calcaneotalar ratio (CTR), and x-ray obliquity (XRO) on the lateral radiographs for each subject. Demographic characteristics were also collected. The mean values of BA, CAG, CL, CH, and CTR were established. Side-by-side comparisons were completed to with respect to age, sex, laterality, and radiograph obliquity. Additionally, side-by side comparisons were performed to assess within subject differences as well as inter-subject variability.

RESULTS: Of the 867 bilateral foot and calcaneus radiographs reviewed, 200 met the inclusion criteria within a 6-month period in 2019. There were 134 female and 66 male subjects with a mean age of 45.9 ± 16.1 years. There was no statistically significant difference in side-by-side measurements of the BA ($p = 0.15$), CAG ($p = 0.43$), CL ($p = 0.20$), or CH ($p = 0.35$). BA ($p = 0.023$), CL ($p < 0.001$), and CH ($p < 0.01$) were found to be smaller in females. XRO had significant effects on the measurements of BA ($p = 0.009$), CAG ($p = 0.021$), CH ($p = 0.040$), and CTR ($p = 0.004$). Side-by-side comparisons showed greater inter-subject variability than within subject differences with ratio of variations greater than 1 for all measurements of interest.

CONCLUSION: Within our cohort, we did not observe any statistically significant differences between side-to-side measurements within the same patient. Gender had the largest effect on several of the measurements. We conclude that the use of contralateral calcaneus films as a template for open reduction and internal fixation of calcaneus fractures is a valid option when necessary.

Paper 37

Fracture Collapse Correlates with Early Functional Outcomes After Cephalomedullary Nailing of Pertrochanteric Hip Fractures

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BACKGROUND: Cephalomedullary nails (CMN) are commonly utilized for the treatment of pertrochanteric femoral fractures. Literature evaluating the relationship between radiographic outcomes and patient reported outcome measures is lacking. The purpose of this study was to determine the effect of radiographic fracture collapse on patient reported outcomes at 3 months from surgery.

PATIENTS & METHODS: As part of a previously published prospective study by Shannon et al, patients with pertrochanteric femur fractures were randomized to treatment with a short nail or long CMN from 2015-2017. Complete clinical and radiographic follow up was available at 3 months from surgical treatment in 119 patients. The average age was 79 years with an average BMI of 26 kg/m² and an overall female predominance (69%). Injury, postoperative and 3-month follow up radiographs were examined for tip-apex distance, calcar gapping, neck shaft angle, lateral screw prominence, and fracture collapse. Fracture collapse was calculated by subtracting immediate postoperative lag screw prominence from 3-month lag screw prominence. Functional outcomes were evaluated by both Harris Hip Scores (HHS) and Short Form (SF-36 scores).

RESULTS: The mean amount of fracture collapse was 4.6 mm. Fracture collapse was negatively correlated with both HHS and SF-36 scores ($p < 0.05$). No other significant correlation between radiographic outcomes and functional outcomes were identified including tip-apex distance, calcar gapping, or postoperative neck-shaft angle. Although fracture collapse remained significantly correlated with functional outcomes among patients treated with a long CMN, it was not a predictor of functional outcomes among the patients treated with a short CMN. Only one patient required revision within our follow-up period and their 3-month collapse was more than a standard deviation above the mean.

CONCLUSION: Controlled fracture collapse, often an expected finding after fixation of pertrochanteric fractures with CMNs, allows for fracture compression with decreased risk of implant cut-out through the femoral head. However, this alteration in proximal femoral anatomy may have negative functional consequences through loss of leg length and proximal femoral offset. In patients treated with a CMN for pertrochanteric femur fractures, we found that the degree of fracture collapse negatively affected early postoperative functional outcomes. Longer term follow-up and larger studies are needed to further delineate the exact consequences of this finding.

Paper 38

Hip Resection Arthroplasty for Acute Native Hip Femoral Neck Fractures in the Non-Ambulator

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PURPOSE: Treatment of femoral neck fractures (FNFs) in patients who are non- or minimal ambulators is generally with hemiarthroplasty (HA). Despite its current standard of care, HA for femoral neck fractures in the non-ambulator is not without risk. These include: 1) implant dislocation, 2) implant failure due to lack of host bony ingrowth, or poor cementation technique, 3) periprosthetic fracture due to the presence of stress risers at the bone/cement-implant interface, 4) prosthetic joint infection (PJI), and 5) fat embolization syndrome during insertion of pressurized cement in cemented HA. To eliminate these risks, we present the use of Girdlestone hip resection (GHR) for FNFs in the non-ambulator. We hypothesized that GHR would result in immediate return to patient baseline function, adequate immediate postoperative pain control, and shorter OR times when compared to HA.

METHODS: This is a retrospective review of five consecutively treated non-ambulatory patients (six hips) that underwent GHR for acute, native hip FNFs. Non-ambulatory status was defined as bedridden, or wheelchair bound with the ability to stand only for transfers. Patients were excluded if they had presence of orthopedic implants in the fractured hip from any prior treatments for any reason, if they were non-ambulatory secondary to cerebral palsy, or if they had an actively septic joint in the fractured hip. Outcomes included procedure length, postoperative vs preoperative VAS pain scores and narcotics usage, and the ability to sit up in bed or a chair postoperatively. Patients were compared to the 10 most recent patients with FNF treated with HA at the authors' home institution. All patients were followed for one year and the HA patients were observed for any arthroplasty-specific complications.

RESULTS: GHR resulted in decreased postoperative vs. preoperative VAS pain scores (7.7 vs 3.3, $p = 0.002$), and decreased operative times (59.2 minutes for GHR, 111.8 min for HA, $p < 0.001$). All GHR patients had immediate return of baseline function. No GHR patients developed any arthroplasty-specific complications, while one HA patient (1/10) developed PJI requiring a return to the OR for irrigation and debridement with explantation.

CONCLUSION: GHR offers shorter operative times when compared to HA, decreased immediate postoperative vs. preoperative VAS pain scores, and immediate return to functional baseline status without possibility of arthroplasty-specific complications. GHR is a viable treatment option for FNFs in the non-ambulator.

Paper 39

Clinical and Biomechanical Effects of Femoral Neck Buttress Plate Used for Vertical Femoral Neck Fractures

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PURPOSE: To investigate both the biomechanical and clinical effect of an inferomedial femoral neck buttress plate (FNBP) used to augment a sliding hip screw (SHS) and anti-rotational screw (ARS) in the treatment of traumatic vertical femoral neck fractures.

METHODS

Part 1: Clinical - Retrospective review of patients under age 65 treated with open reduction of a vertical femoral neck fracture through an anterior approach. All fractures were stabilized through a separate lateral incision for placement of a 2-hole sliding hip screw (SHS) and anti-rotation screw (ARS) perpendicular to the fracture plane. Patients were divided into two groups: Group 1 patients had SHS/ARS fixation augmented with a FNBP, while Group 2 patients had SHS/ARS fixation alone and were matched for sex and age to the patients in Group 1. Demographic data, OTA fracture classification, immediate postoperative and follow-up radiographs were analyzed for quality of reduction, femoral neck shortening (FNS), neck-shaft angle (NSA), avascular necrosis (AVN), and union.

Part 2: Biomechanical - A Pauwels III femoral neck osteotomy was created in five pairs of cadaveric specimens, each fracture was reduced and stabilized with a SHS/ARS construct. One specimen was randomly assigned to Group 1 with a FNBP. The other specimen was assigned to Group 2 with SJS/ARS construct alone.

RESULTS

Part 1: There were 18 matched patients (14 males and 4 females) in both Group 1 and Group 2. The median follow-up was 9.5 months in Group 1, and 8.5 months in Group 2. The median Pauwels angle was 71.5 degrees for Group 1, and 72.5 degrees for Group 2 ($p = 0.75$). There were no statistically significant differences between the two groups with respect to Pauwel's angle, femoral neck shortening, changes in neck-shaft angle, AVN, or nonunion.

Part 2: All five cadaveric specimens in both groups survived the 10,000-cycle loading regimen. We were unable to detect any significant differences between the two groups with respect to construct stiffness, change in neck-shaft angle or amount of femoral neck shortening.

CONCLUSION: Supplemental inferomedial buttress plates to augment a sliding hip screw and anti-rotational screw in the treatment of traumatic vertical femoral neck fractures in young patients does not appear to offer either a biomechanical or clinical benefit.

Paper 40

Comparison of Hospitalist and Trauma Surgery Admitting Services in Perioperative Hip Fracture Patient Management

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INTRODUCTION: Expeditious operative management of patients with hip fractures reduces mortality, hospitalization length, complications, and has cost implications. At our Level II trauma designated hospital, a recent change in admitting service was made from the hospitalist service to the trauma surgery service.

OBJECTIVE: To compare time to surgery, length of stay, in hospital mortality rate, and 30-day readmission rate pre and post implementation of admitting service change in management of elderly patients with hip fractures.

METHODS: We retrospectively reviewed all patients 65 and older admitted with a low energy hip fracture one year before and after the change in admitting service. We excluded polytraumatized patients with high energy injuries and patients transferred from outlying hospitals. Collected data included demographics, fracture type, surgery type, American Society of Anesthesiologists Classification (ASA Class), Charlson Comorbidity index (CCI), time to surgery, perioperative consults, length of stay, mortality, and readmission rates. Quantitative patient characteristics were compared using a two-sample t test, and nominal characteristics were compared using a Chi-square test.

RESULTS: A total of 208 patients met inclusion criteria, 115 before and 93 after the change in admitting service. Although there was a trend towards shorter time to surgery for patients admitted to the trauma service (22.3 ± 9.2 hours) compared to the medicine service (25.0 ± 15.2 hours), this did not reach statistical significance ($p = 0.17$). The length of stay decreased from 5.8 ± 3.8 days on the hospitalist service to 4.6 ± 2.7 days on the trauma surgery service ($p = 0.0015$). There were no significant differences in demographics, CCI score, perioperative consults, mortality, and readmission rates. ASA Class distribution was similar between the two cohorts.

CONCLUSION: The change from a hospitalist-based admitting service to a trauma surgery-based service resulted in a similar time to surgery, but a decreased length of stay for elderly hip fracture patients with no differences in early mortality or readmission rates.

Paper 41

Effect of Dedicated Surgical Staff on Operative Time and Turnover in Elective Total Joint Arthroplasty

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PURPOSE: To evaluate the effect of intraoperative surgical staff turnover on operative times and complication rates for primary joint arthroplasty (TJA).

SIGNIFICANCE: Non-orthopedic literature has demonstrated an association between surgical staff turnover and increased operative times, however, the effect of intraoperative staff turnover in TJA is poorly understood.

METHODS: Operative timepoints, surgical staff, postoperative complications, and length of stay (LOS) were collected from medical records for 2,216 primary TJAs. Univariate analysis was performed to evaluate effect of intraoperative surgical staff turnover on operative times and complication rates.

RESULTS: Intraoperative scrub turnover occurred in 51.4% of cases and correlated with significantly longer operating (134.9 vs. 126.6 minutes, $p < 0.0001$), total OR (164.9 vs. 155.8 minutes, $p < 0.0001$), and TSC times (206.2 vs. 200.2 minutes, $p = 0.0115$). There were similar complication rates (2.7% vs. 2.0%, $p = 0.2974$).

Intraoperative circulator turnover occurred in 20.4% of cases and correlated with significantly longer operating time (139.1 vs. 128.7 minutes; $p < 0.0001$), total OR time (170.2 vs. 157.9 minutes, $p < 0.0001$), TSC time (214.3 vs. 200.1 minutes; $P < 0.0001$), and LOS (2.04 vs. 1.76 days; $p < 0.0016$). There were similar complication rates (2.2% vs. 2.4%, $P = 0.7736$).

CONCLUSION: Minimizing surgical staff turnover may lead to increased OR efficiency and shorter LOS in primary TJA.

Paper 42

Creation of a Total Hip Arthroplasty Patient-Specific Dislocation Risk Calculator

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BACKGROUND: Many risk factors have been described for dislocation following total hip arthroplasty (THA), yet a patient-specific risk assessment tool remains elusive. The purpose of this study was to develop a high-dimensional, patient-specific risk-stratification nomogram that allows dynamic risk modification based on operative decisions.

METHODS: 29,351 THA performed between 1998-2018 were evaluated including 21,978 primary and 7,373 revision cases. During mean 6-year follow-up, 1,522 THA sustained a dislocation. Patients were characterized on non-modifiable factors (demographics, THA indication, spinal disease, spine surgery, neurologic disease, connective tissue disease), and modifiable operative decisions (surgical approach, femoral head diameter, acetabular liner [standard/elevated/constrained/dual mobility]). Multivariable regression models and nomograms were developed with dislocation as a binary outcome at 1-year and 5-years postoperatively.

RESULTS: Patient-specific dislocation risk was wide-ranging from 2%-16% at 1-year and 3%-24% at 5-years in primary THA, and 7%-35% at 1-year and 10%-46% at 5-years in revision THA. In primary THA, direct anterior approach and lateral approach decreased risk compared to posterior approach (HR = 0.27 and HR = 0.58, respectively). In primary THA, when adjusting for approach, the combination of femoral heads ≥ 36 mm and elevated liners yielded the largest decrease in risk (HR = 0.28), followed by dual mobility constructs (HR = 0.47). In revision THA, the adjusted risk of dislocation was most markedly decreased with dual mobility constructs (HR = 0.34), followed by femoral heads ≥ 36 mm and elevated liners (HR = 0.60). In revision THA, adjusted risk of dislocation was decreased with acetabular revision, irrespective of whether other components were revised (HR = 0.60).

CONCLUSION: This patient-specific dislocation risk calculator is strengthened by a robust multivariable model that accounts for comorbidities associated with instability and demonstrates wide-ranging patient-specific risk based on comorbid profile. The resultant nomograms can be used as a screening tool to identify high-risk THA patients and individualize operative decisions. Further refinement will include deep learning-assisted preoperative imaging and acetabular component position assessment.

SUMMARY: This patient-specific dislocation risk calculator demonstrates wide-ranging risk based on comorbid profile and enables surgeons to quantify risk mitigation based operative decisions.

Paper 43

The Fate and Relevance of the Patella in Two-Stage Revision Total Knee Arthroplasty for Periprosthetic Joint Infection

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BACKGROUND: It is unclear whether reimplantation of a patellar component during two-stage revision for total knee arthroplasty periprosthetic joint infection (PJI) affects patient reported outcome measures (PROMs) or implant survivorship. The purpose of this study was to evaluate whether resurfacing the patella during reimplantation confers a functional benefit or increases implant survivorship after two-stage treatment for PJI.

METHODS: After confound exclusions, a retrospective study of 103 consecutive two-stage revisions for knee PJI at a single tertiary academic center was performed. Patient demographics, comorbidities, Knee Society scores, KOOS JR score, UCLA Activity Level, satisfaction, postoperative assistive device use, implant survivorship, and radiographic patellar tilt and displacement were compared in patients who underwent reimplantation with and without a patellar component. Statistical analysis of outcomes and minimally clinical important differences in PROMS were evaluated.

RESULTS: 43 patients (41.7%) underwent reimplantation with a patellar component and 60 patients (58.3%) without a patella component. Demographics of age, BMI, sex, and ASA did not differ between groups ($p \geq 0.156$). At mean follow-up of 30 months, there were no differences in postoperative use of assistive devices ($p = 0.098$), pain with walking ($p = 0.714$) or stairs ($p = 0.318$), or satisfaction (0.245) with numbers available. Radiographically, 68% of patients with unresurfaced patellae demonstrated >4 mm of postoperative lateral patellar displacement compared to 40% of resurfaced patellae ($p = 0.011$). Further, 66% of resurfaced patellae remained within 4 mm of preoperative displacement, compared to 30% of unresurfaced patellae ($p = 0.007$). However, PROMS did not differ based on patellar displacement ($p > 0.130$). No difference was observed in all-cause reoperation survivorship ($p = 0.679$).

CONCLUSION: Following two-stage revision for knee PJI, patellar resurfacing minimizes deleterious lateral patella displacement, likely via mechanical constraint within the femoral trochlea. However, resurfacing does not appear to significantly impact postoperative PROMs or survivorship. It is acceptable to avoid resurfacing the patella at reimplantation if bone loss creates excessive risk.

Paper 44

Failures after Two-Stage Exchanges are Secondary to New Organisms Not Previously Covered by Antibiotics

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INTRODUCTION: Prior studies have shown that the majority of re-infections following two-stage revisions are due to organisms different from the initial organisms identified. It remains unknown whether these new organisms were susceptible to the antibiotics given (indicating the patient likely developed another infection following successful treatment) or not susceptible (indicating these organisms may have been initially present, but were not identified, and thus, inadequately treated). The purpose of this study was to determine if bacteria identified at the time of re-infection following two-stage revisions were susceptible to the antibiotics administered during treatment of the index infection, in an effort to understand if these are new infections or from organisms that were present but not initially identified on culture.

METHODS: Thirty failures (19 knees and 11 hips) following two-stage revisions from four institutions were identified. Cultures and antibiotic sensitivities were used to determine whether the initial and re-infectious organisms were new and if re-infectious organisms were susceptible to the antibiotics initially given during treatment of the index infection.

RESULTS: Twenty-five (83.3%) of the 30 re-infections were due to new organisms. Of these re-infections from new organisms, 16 of 25 (64.0%) were susceptible to the antibiotics previously administered, suggesting that they were likely new infections rather than persistent infections from organisms that were not detected during initial treatment. No statistically significant differences in demographics or time to revision were observed when comparing by organism type (new vs. repeat) or by antibiotic susceptibility.

CONCLUSION: Failures following two-stage revisions are frequently due to organisms different than those identified prior to two-stage revision and are likely new infections rather than persistent infections from bacteria that were not detected at the time of initial treatment.

Paper 45

COVID-19 Infection After Total Joint Arthroplasty is Associated an Increased Risk of Post-Operative Complications

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BACKGROUND: The impact of a postoperative diagnosis of COVID-19 in patients undergoing total joint arthroplasty (TJA) remains unknown. The objective of this study was to characterize the effect of COVID-19 infection following TJA on perioperative complication rates.

METHODS: The Mariner database was queried for patients undergoing primary total hip (THA) and total knee arthroplasty (TKA). TJA patients who were diagnosed with COVID-19 within 90 days postoperatively were matched in a 1:3 fashion based on age, gender, and Charlson Comorbidity index (CCI) with patients who were not diagnosed with COVID-19. Preoperative comorbidity profiles and complications within 3 months of surgery were compared. Statistical analysis included chi-squared tests and multivariate logistic regression with outcomes considered significant at $p < 0.05$.

RESULTS: Of the 257 COVID positive patients, 144 (56.1%) underwent primary THA and 113 (43.9%) TKA. On univariate analysis, COVID infection was associated with a higher incidence of DVT (5.8% vs. 1.2%; $p < .001$), PE (5.8% vs. 1.0%; $p < .001$), acute kidney injury (21.0% vs. 7.4%; $p < .001$), cardiac arrest (3.5% vs. 0.3%; $p < .001$), pneumonia (52.5% vs. 4.6%; $p < .001$), UTI (17.9% vs. 10.7%; $p = 0.003$), and all complications (47.1% vs. 24.4%; $p < .001$). On multivariate analysis, a postoperative COVID diagnosis was associated with an increased odds of DVT (OR: 5.21; 95%CI [2.29-12.56]), PE (OR: 5.87; 95%CI [2.52-14.75]), and all complications (OR: 2.80, 95%CI [2.08-3.77]). The incidence of DVT/PE was greater the closer the COVID diagnosis was to the surgical procedure (5.24x at 1 month, 4.62x at 2 months, and 0.97 times at 3 months, $p < 0.001$). Similarly, the incidence of all complications was greater the closer the COVID diagnosis was to the surgical procedure (2.72x at 1 month, 2.70x at 2 months, and 2.52x at 3 months, $p < 0.001$).

CONCLUSION: Patients diagnosed with COVID-19 within 3 months of TJA have a significantly greater incidence of postoperative complications. The risk of developing these complications is greater if the COVID-19 infection occurs closer in time to the surgical procedure.

Paper 46

A Major Increase of Thromboembolism in Total Hip/Knee Arthroplasty Patients during COVID-19 Pandemic

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INTRODUCTION: The first known COVID-19 patient in the US was reported on 1/20/2020. We noted an increase of thromboembolic-events among total hip/knee arthroplasty (THA/TKA) patients since then. Therefore, we sought to determine (1) incidences of pulmonary-embolism (PE) and/or deep-vein-thrombosis (DVT) among THA/TKA patients in the months before and after 1/20/2020 and (2) thromboembolic-event rates separately for primary/revision cases.

METHODS: Based on electronic-medical-records analytics, we retrospectively obtained total number of patients (monthly) who underwent primary/revision THA/TKA in our institution between 12/1/2018 and 3/31/2021. Monthly number of patients with PE and/or DVT was also established. Unit of analysis was number of patients. Monthly rates of thromboembolic-events were calculated and figures were created showing the progression throughout time of these events (PE/DVT, PE, and DVT). Cutoff-date used to set apart periods before/after COVID-19 was 1/20/2020.

RESULTS: Overall, 312 patients had thromboembolic-events [PE (n = 102), DVT (n = 242), both (n = 32)] among 19,068 patients who underwent THA/TKA during the study period for a global rate of 1.6%. The global rate of thromboembolic-events in the months before 01/20/2020 was 1.2% (119/9,545) while it was 2.0% (193/9,523) after that date. Incidences of thromboembolic-events on April/June/July of 2020 were 3.4%/3%/3.4%, respectively. A major increase, when compared to the rates for the same three months in 2019 (1.3%/1%/1%, respectively). An unusually high PE incidence was observed on April/2020 (3.44%), this rate was more than three times the one observed in any other month. After January/2020, there was a major increase on PE/DVT rates in primaries, but even higher on revisions: 6% in five different months, including 11.5% on November/2020.

CONCLUSION: There was a major increase of PE/DVT events among THA/TKA patients during the COVID-19 pandemic, particularly among revision patients. Spikes of these events coincided with COVID-19 peaks observed at our institution. Currently, patients should be counseled about this increased risk.

Paper 47

Complication Rates and Costs of Hip Resurfacing Compared to Total Hip Arthroplasty at Five Years

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INTRODUCTION: Hip resurfacing is an alternative to total hip arthroplasty (THA) that may improve function in young, active patients. The purpose of this study is to compare the complication rates and cumulative costs associated with resurfacing and THA at 5-year follow up.

METHODS: We retrospectively reviewed 1,537 patients who underwent resurfacing and 78,743 THA using the PearlDiver Database from 2010-2020, with 5-year follow-up. Propensity score matching was performed to compare resurfacing and THA patients matched by age, gender, and comorbidity status. Demographics, comorbidities, complication rates, and surgical hip related costs were compared. Markov decision modeling was used to assess the lifetime cost-effectiveness of hip resurfacing compared to THA.

RESULTS: Univariate analysis of the matched cohorts revealed a lower incidence of obesity (11.8% vs. 14.4%, $p = 0.034$) and a higher incidence of coagulopathy (3.6% vs. 2.2%, $p = 0.019$) in the resurfacing group vs. THA group. Resurfacing was associated with higher rates of periprosthetic fracture (2.8% vs. 0.5%, $p < 0.001$), revision surgery (4.8% vs. 2.6%, $p < 0.001$), complications (13.6% vs. 8.5%, $p < 0.001$), but a lower dislocation rate (0.9% vs. 2.4%, $p < 0.001$) compared to THA. Multivariable logistic regression showed an increased rate of any complication with resurfacing (OR 1.68, 95% confidence interval 1.29-2.12, $p < 0.001$). Ninety-day costs of resurfacing were less than THA (\$23,880 vs. \$25,791, $p < 0.001$) and remained less at 5 years (\$25,011 vs. \$27,668, $p < 0.001$). The average cost of revision of a resurfacing was nearly \$11,000 less than revision THA (\$27,117 vs. \$38,013, $p < 0.001$). Resurfacing was associated with average lifetime savings between \$1,293 at age 40 years and \$1,641 at age 70 years.

DISCUSSION: Compared to THA, resurfacing is associated with significantly higher revision and complication rates. However, our results suggest that there is a substantial cost benefit with hip resurfacing as revision surgery is less costly.

Breakout Session #4 (Hip and Knee Arthroplasty Complications and Infections)
Thursday, April 07, 2022

Paper 48

Skeletal Muscle Mass Loss Following Knee Arthroplasty Compared to Hip Arthroplasty

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INTRODUCTION: Bioimpedance Analysis (BIA) is an emerging tool for identifying body composition including body fat, body water, and skeletal muscle mass (SMM). While BIA has been introduced in other specialties, its role has yet to be established in orthopedic surgery. This study aimed to identify changes in skeletal muscle mass (SMM) in patients following total hip arthroplasty (THA) compared with total knee arthroplasty (TKA).

METHODS: This prospective cohort study recruited patients undergoing primary THA or TKA. Multi-frequency BIA was performed at the preoperative surgical work-up visit and postoperatively at 3 and 6 weeks (\pm 1 week) following their procedure. The primary outcome was change in SMM. Analysis of descriptive statistics and comparison of means was conducted.

RESULTS: 85 patients scheduled for elective THA or TKA underwent their scheduled procedure, where 42 patients (48.3%) underwent THA. Of those undergoing THA, 33 were performed using a posterior approach and 9 were performed via the direct anterior approach.

CONCLUSION: BIA allows for rapid, non-invasive, longitudinal assessments of body composition, which may be a useful tool for surgeons monitoring their patients' postoperative course. Using a direct anterior approach rather than a posterior approach for THA allowed patients to nearly reclaim their initial SMM loss by week 6, which corroborates claims that the direct anterior approach is muscle sparing. Further studies are needed to further elucidate these associations given the small sample sizes; however, this is an inviting arena of ongoing and future research.

Paper 49

Efficacy of Saline Irrigation Plus Local Use of Polyvinyl Alcohol Polymer Composite Doped with Vancomycin And Tobramycin (PVA-VAN/TOB-P) In A Mouse Pouch Infection Model

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INTRODUCTION: The efficacy of saline irrigation for treatment of periprosthetic infection (PJI) is limited due to the presence of the contaminated implant. Our study purpose was to evaluate the efficacy of locally placed Polyvinyl Alcohol polymer composite doped with Vancomycin (PVA-VAN-P) or Vancomycin and Tobramycin (PVA-VAN/TOB-P) for infection treatment after saline irrigation in a mouse pouch infection model.

METHODS: Sutures were implanted into air pouches of 36 BALB/cJ mice, then inoculated with *S. aureus*. Mice were randomized into 6 groups (n = 6 for each group): (1) no bacteria; (2) no wash; (3) wash only; (4) wash+PVA-P; (5) wash+PVA-VAN-P, and (6) wash+PVA-VAN/TOB-P. After seven days, pouches were washed alone or with injection of 0.2 ml of PVA-P composites. Sacrifice occurred 14 days after washing. Histology was performed on the pouch tissues and cultures on the washouts.

RESULTS: A biphasic release of VAN and TOB was observed from PVA-P composite (initial burst then sustained delivery for one month). Bacterial culture data (OD) showed that the persistent infection that remained after saline irrigation (0.10 ± 0.14) was eradicated by the addition of PVA-VAN-P (0.05 ± 0.09) and PVA-VAN/TOB-P (0.002 ± 0.003 , $p < 0.05$), respectively. The infection control effects were confirmed by histologic analysis. Importantly, no residues of the PVA-P composites were detected in either the pouch washouts or pouch tissues and a foreign body response to the injected PVA-P was not detected.

CONCLUSION: PJI is common and problematic and few innovations have changed clinical practice and/or outcome. Data generated from this study confirmed that the effect of saline irrigation was very limited in the presence of contaminated sutures. Antibiotic-doped PVA-P composite is biodegradable, biocompatible, and was effective in eradicating bacteria retention after saline irrigation in the presence of medical device associated infection. We propose application of antibiotic-doped PVA-P composite into the wound after saline irrigation for better prevention/treatment of PJI.

Paper 50

Influence of Antibiotic Timing on Native Knee Septic Arthritis Bacterial Culture Results

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INTRODUCTION: Native knee septic arthritis can cause significant morbidity and mortality. Irreparable joint damage with corresponding debility occurs with both late and insufficient treatment. Furthermore, this condition's estimated case fatality rate stands near 11%. Unfortunately, due to management differences between primary referral fields and orthopedics, antibiotic administration timing for patients presenting with possible septic arthritis lacks standardization. Early administration of empiric antibiotics can benefit patients by expediting recovery. However, should empiric therapy fail, a lack of a discernable organism on culture secondary to early antibiotic administration can obscure next steps in management. This study aims to determine the influence of antibiotic administration timing on bacterial culture results for the diagnosis of native knee septic arthritis.

METHODS: A retrospective chart review at a single academic center in the United States was performed to identify all patients that were treated surgically for septic arthritis of the knee from January 2007 to August 2018. Demographic information, culture results (including synovial WBC/PMN%), and timing of antibiotic administration were collected. Data was analyzed using a multivariate logistic regression model.

RESULTS: Overall, 36 of 91 cultures (40%) were positive when antibiotic administration preceded sample procurement. 32 of 83 (39%) cultures were positive when antibiotic administration did not precede sample procurement. Controlling for patients' sex, and accounting for timing in the regression model, patients were less likely to be culture positive if they received their antibiotic 24 hours or greater before culture (OR = 0.38; $p = 0.06$). However, there was no association between when patients received their antibiotic and their aspirate WBC value (OR = 0.28; $p = 0.35$). Patients who received antibiotics before aspirate had an average WBC count of 103,331 ($\pm 19,897$) and PMNs of 92% and those that received antibiotics after aspiration had an average WBC count of 91,162 ($\pm 11,650$) and PMNs 87% ($p = 0.582$ and $p = 0.104$).

CONCLUSION: Antibiotic administration prior to obtaining a culture had no effect on the WBC count or PMN percentage, but if given 24 hours prior to the culture, decreased the likelihood of a positive culture.

Paper 51

Predictors of Native Joint Septic Arthritis in the Setting of Crystalline Arthropathy

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INTRODUCTION: Septic arthritis is an orthopedic emergency. Diagnosis is difficult in patients with concomitant crystalline arthropathy (gout or pseudogout). The symptomatology of crystal arthritis mimics septic arthritis, clouding clinical diagnosis. Arthrocentesis and synovial fluid analysis are the standard diagnostic tests for both pathologies. Crystals on microscopy are diagnostic of crystal arthritis, however their presence does not rule out septic arthritis. Septic arthritis is diagnosed by positive microbiology culture. Though septic arthritis is associated with elevated synovial total nucleated count (TNC), TNC elevations can also occur with gout. The literature suggests that a TNC count of $> 50,000$ cells in a crystal-positive joint should raise suspicion for concurrent septic arthritis, however, data is limited. Further diagnostic indicators are needed to help clinicians promptly identify crystal positive septic arthritis as the treatments and prognoses are different.

METHODS: Patients were retrospectively identified who had arthrocentesis of a native joint positive for monosodium urate (MSU) and/or (CPPD) crystals. Laboratory data was collected including: synovial fluid cultures, total nucleated cell count (TNC), percent polymorphic neutrophils (%PMN), and crystal analysis; and serum CRP, ESR, and white blood cell count (WBC). Statistical analysis performed using Spearman correlation, Univariate-Fischer's exact and Wilcoxon tests, and multivariate analysis.

RESULTS: 442 joints identified with positive CPPD and/or MSU crystals, 31% female, 69% male. Of 442 aspirates, 58 had positive cultures. Patients were more likely to have positive cultures if synovial TNC $> 50,000$ (odds ratio 7.7), CRP ≥ 10 mg/dL (OR 3.2), PMN $\geq 90\%$ (OR 2.17), and if the patient was female (OR 1.9), all were statistically significant with $p < 0.05$. There were 55 patients who underwent irrigation and debridement based on clinical suspicion or a positive gram stain, 37 of these ultimately had a positive culture (67%), the remaining 18 had negative cultures.

CONCLUSION: Results are consistent with the literature, a TNC $> 50,000$ warrants a high suspicion for concurrent septic arthritis and should prompt providers to critically evaluate other patient laboratory data. Results further suggests that a patient with positive crystals, synovial TNC $> 50,000$ cells, PMN $> 90\%$, and serum CRP > 10 mg/dL is at high risk for having a concurrent septic arthritis and may warrant urgent irrigation and debridement and antibiotic therapy. This data serves as a supporting to develop an infection risk calculator for crystal positive septic arthritis.

Paper 52

Clinical Effectiveness of Serum D-Dimer in Evaluating Periprosthetic Joint Infections (PJI) in Total Knee Arthroplasty (TKA)

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INTRODUCTION: One of the most significant complications in total knee arthroplasty (TKA) remains periprosthetic joint infections (PJI). Several new diagnostic criteria have been proposed with the most recent 2018 international Consensus Meeting (ICM) including D-dimer. The purpose of this study was to validate the utility of D-dimer for PJI diagnosis in TKA.

METHODS: A retrospective review of prospectively collected data identified 282 consecutive patients with work-up for painful total joint arthroplasty from August 2017 until May 2021. We included 191 patients assessed after TKA; 144 patients assessed after primary TKA and 47 following revision procedures. Patients without D-dimer, ESR and CRP as part of a PJI work-up were excluded. Additional tests investigated included synovial aspiration WBC count, PMN%, intraoperative histology, as well as further diagnostic work-up.

RESULTS: From our cohort, 96 had a positive D-dimer ($>860 \mu\text{g/L}$), out of which 14 were clinically diagnosed with PJI. 15 patients in total were diagnosed with PJI. D-dimer was associated with a sensitivity of 93.3%, specificity of 53.4%, PPV of 14.6% and NPV of 98.9%. From the 15 PJI patients, 8 had all 3 screening tests (D-dimer, CRP and ESR) return positive (per ICM cutoffs) and all 15 had at least ESR and/or CRP positive. No cases were confirmed with positive D-dimer alone. Three lower extremity dopplers and 1 chest angiogram were ordered by other providers in response to positive D-dimer, all with no findings of acute thrombus/emboli.

CONCLUSION: While D-dimer has a high sensitivity alone, positive results do not further detect TKA PJI compared to CRP and ESR. Caution should be exercised when interpreting results, as there is no standardization in reporting D-dimer assays, to avoid unnecessary joint aspirations alongside expensive testing (angiogram and doppler). Investigation of various cut-off levels may improve the utility of D-dimer in screening for PJI.

Paper 53

ERAS Application Factors that Predict Outstanding Residency Performance

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INTRODUCTION: Orthopedic surgery residency programs received an average of 85.7 Electronic Residency Application Service (ERAS) applications per residency position in 2018, a number that increases each year. Three-digit United States Medical Licensing Exam (USMLE) Step 1 scores, often used as a screening tool to reduce application burden, are being eliminated in 2022. We sought to identify the components of ERAS applications that predict outstanding residency performance.

METHODS: Following IRB approval, 10 faculty with ≥ 7 years of involvement at a midwestern, urban, academic orthopedic surgery residency were administered an anonymous survey on the performance of the last four classes of residency graduates (24 residents). Each faculty member graded each resident on a 1-10 scale (higher is better) on six criteria: 1) surgical technical skills, 2) research productivity, 3) clinical knowledge, 4) professionalism, 5) personality, 6) fellowship match. The ratings for these six criteria were averaged to produce an "overall residency performance score". ERAS application factors were reviewed and correlated with the overall residency performance score univariately. Application factors with $p < 0.2$ on univariate analysis were included in a stepwise linear regression model. Statistical significance was set at $p < 0.05$.

RESULTS: The mean overall performance score was 7.9 ± 1.2 (range 5.1-9.6). Median USMLE Step 1 score was 246 ± 11 (range 230-270). 42% of residents had been selected to the Alpha Omega Alpha (AOA) honors society. On univariate analysis, ≥ 5 honors grades in core clerkships, ≥ 3 exceptional letters of recommendation based on key phrases or comments, and research track (6-year) residents were correlated with improved overall residency performance. Each of these factors remained significant on multivariate analysis. USMLE scores, AOA status, research years before residency, number of publications, and number of volunteer experiences were not associated with improved residency performance.

CONCLUSION: Past clinical excellence, measured objectively by core clerkship grades and subjectively by exceptional letters of recommendation, predicts improved overall residency performance. Traditionally used screening factors (e.g., USMLE scores, AOA, number of publications) may not be as useful in identifying successful future residents.

Paper 54

The Impact of Virtual Residency Interviews During Covid-19 on Orthopedic Surgery Applicants

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BACKGROUND: The cost of applying to orthopedic surgery residency has been increasing due to increases in the number of applications. Therefore, following virtual interviews in 2020-2021 due to Covid-19, changes to the interview process, including continuing virtual interviews as well as application and interview limits have been proposed. The number of programs that applicants are applying to have been steadily increasing, but it is unknown the effect that virtual interviews had on the number of applications and the effect that virtual interviews had on students' experience.

METHODS: Students from 4 graduating classes (n = 608, years 2017-2020) and students from the 2021 class (n = 144) were surveyed following the NRMP match and reported the number of programs applied to, number of interviews offers offered, and interviews attended. The 2021 class was also asked, "How did virtual interviews affect your interview experience?" Student's t-test was used to compare numerical values and free response data was first categorized into positive, negative, or neutral and then into 7 themes.

RESULTS: Prior to and during virtual interviews orthopedic applicants applied to more programs, received more interview invites, and attended more interviews than applicants to other specialties (82.3 vs. 36.9 p-value = <0.001, 23.2 vs. 16.4 p-value = 0.009, 15.6 vs. 12.3 p-value = 0.003) in 2021, total programs applied to, interview invites received, and interviews attended by matched orthopedic applicants (n = 5) was not significantly different from prior years (n = 14) (76.6 vs. 81.5 p-value = 0.67, 23.4 vs. 22.8 p-value = 0.91, 15.8 vs. 15.4 p-value = 0.89). Prior to virtual interviews, students who matched into orthopedic surgery spent \$8,838.80 on applications and interviews, with \$7,020 being interview expenses. Virtual interviews reduced interview expenses to \$0.

127 responses to the free response question. 36 had a positive experience, 44 were neutral, 47 were negative with emerging themes including 15 noted interviews being cheaper, 18 noted more convenient/less time, 18 were able to attend more interviews, 38 note difficulty assessing program fit, 19 want to see the program or city in person, 8 had increased interest in home/local programs, 6 said it was difficult to make connections or stand out.

CONCLUSIONS: Virtual residency interviews do not significantly alter the number of programs applied to, interviews offered, or number of interviews attended for match orthopedic applicants. However, it does significantly decrease the cost associated with traveling and completing interviews. Most students reported that virtual interviews were either a positive or neutral experience with the main negative effect being difficulty assessing fit of the program.

Paper 55

Financial Literacy in Orthopaedic Surgery Residents

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INTRODUCTION: Financial literacy is an important education topic in resident training across all specialties. It is likely overlooked, as the Accreditation Council for Graduate Medical Education (ACGME) does not require programs to educate residents on this topic and programs are already challenged to balance educational time. Financial concerns, however, are a reality for educational trainees. The purpose of this study is to perform a comprehensive evaluation on financial literacy and financial attitudes of a large multi-regional cohort of orthopedic residents.

METHODS: A 46-question anonymous survey was administered to 1,028 orthopedic surgery residents at 43 programs from April 7 until June 7, 2020. Responses of at least 80% completion were included for analysis. Questions included pertained to resident demographics, knowledge of finance and investment topics, and application of financial principles/personal financial status.

RESULTS: The response rate was 48% (494 of 1028). The average age of respondents was 29.9 years (+/- 2.5 years), and residents studied were distributed evenly across postgraduate year (PGY) training (PGY1-PGY5+). Average financial literacy score was 60.9%. Of respondents, financial literacy scores were higher in residents with greater childhood annual household income, no credit card debt, higher levels of individual parent education, and active retirement savings plans. According to responses, 35.5% of residents were satisfied with current financial situations. Most had student debt (77.5%) and had not undergone formal financial and practice management training. Almost 50% noted that financial management training was inadequate, and 52% declared that they would like more training in these areas.

DISCUSSION & CONCLUSION: Orthopedic residents show significant deficits in overall financial and investment knowledge combined with an overall dissatisfaction with financial situations while in residency. Furthermore, residents desire more program-sponsored training and access to resources. Opportunity exists for programs to enhance the resident education experience and quality of life with financial education.

Paper 56

"If Everyone is Special, Then No One Is" Do Standardized Letters of Recommendation Identify Top Applicants for Orthopedic Residency?

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BACKGROUND: Orthopedic surgery residency programs are among the disciplines that use a standardized letter of recommendation (SLOR) to stratify applicants. Although some studies have found that SLORs produce a range of scores across applicants, others have identified 'grade inflation'. No study has directly addressed the SLOR's usefulness in identifying the most highly qualified applicants.

OBJECTIVE: The primary objective was to evaluate letter authors' ratings of the SLOR domains and summative statements for ceiling effects which could prevent it from facilitating selection of the most highly qualified applicants to interview.

METHODS: SLORs submitted to our institution for the 2018 orthopedic surgery residency match were downloaded from the Electronic Residency Application Service®. A ceiling effect was defined as $\geq 15\%$ of ratings for a SLOR domain or summative statement occurring at the top of the scale. Ninety-five percent confidence intervals were calculated for the proportions of top-of-the-scale ratings.

RESULTS: Analysis of 177 SLORs represented academic and community programs from all geographic regions within the United States. Large ceiling effects were found across all domains and the summative statements (range: 41%-70% top-of-scale ratings). Twenty-two percent of applicants received top-of-scale ratings on all domains and 43% were ranked to 'guarantee a match'. Non-university-based ($p = 0.0155$) and north central- and mountain/pacific-based authors ($p = 0.0419$) were more likely to give top-of-scale ratings for all domains.

CONCLUSIONS: Our data show that orthopedic surgery residency SLORs from the 2018 match were limited by ceiling effects and did not provide information useful for selecting candidates to interview.

Paper 57

The Impact of COVID-19 on the Social Media Practices of Orthopaedic Surgery Residency Programs

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INTRODUCTION: Social media is a robust tool that allows residency programs to communicate with the next generation of applicants. As recently as 2018, only 15.7% of orthopedic surgery departments had a Twitter account. The COVID-19 pandemic posed numerous challenges for residency programs including finding new ways to communicate with applicants. Social media provided a contactless mechanism for programs to outreach with prospective applicants therefore we theorized that orthopedic residency social media activity increased during the pandemic.

METHODS: An analysis of orthopedic surgery residency social media accounts was performed to identify changes in practices over the period spanning the COVID-19 pandemic. A review was performed to determine the social media (Twitter and Instagram) activity of each orthopedic residency program over an 18-month period from July 2019 to December 2020. Social media participation was analyzed with respect to program type, location, size, geographical location, and doximity ranking. Study variables were compared using t-test for continuous variables and Chi-Square for categorical variables.

RESULTS: A total of 194 residency programs were included in this study. The prevalence of orthopedic residency Twitter accounts increased from 56 (28.9%) in December 2019 to 87 (44.8%) in January 2021. During this period, the number of residencies with Instagram accounts increased from 16 (8.2%) to 107 (55.2%). Programs averaged 669 Twitter and 1,026 Instagram followers per account, which was significantly associated with the doximity ranking of each program ($p < 0.05$). Allopathic programs, programs with a higher doximity Reputation Ranking, and those with more than 35 residents were significantly more likely to have an Instagram or Twitter account ($p < 0.05$). Although not statically significant, there was a trend towards a decrease in the average number of Twitter posts per month between July 2020 and December 2020 as compared to the same period in 2019. While there was a trend towards an increase in the average number of Instagram posts per month between July and December 2020, these findings were significant in July and September ($p < 0.05$).

CONCLUSION: There was an increase in the prevalence of orthopedic social media accounts in the period surrounding the Covid pandemic. There was a trend towards increased adoption of Instagram during this period. Allopathic programs, programs with a higher doximity Reputation Ranking, and larger programs were more likely to utilize social media.

Paper 58

High Satisfaction With Use Of Telehealth For Routine Follow-up Care After Total Joint Arthroplasty In A VA Healthcare System

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BACKGROUND: During the COVID-19 pandemic, the [institution blinded for review] Orthopedic Section substituted postoperative clinic visits with phone-calls at 6 to 12 months post shoulder, hip, and knee arthroplasty. The purpose of this study was: (1) To evaluate patient satisfaction with telehealth follow-up after total joint replacement; and (2) To identify risk factors for low satisfaction with telehealth follow-up. We hypothesized that most patients would be satisfied with telehealth in lieu of in-person visits. We also hypothesized that lower satisfaction with telehealth would correlate with increased number of mental and physical health co-morbidities, patient proximity to the [institution blinded for review], and dissatisfaction with surgical outcome.

METHODS: All postoperative patients who received telephone follow-up with an orthopedic provider from April to June 2020 were identified. Patients were called and administered a standardized survey to assess satisfaction with surgery and the telehealth experience using the Likert scale. Personal preference for type of postoperative appointments was recorded. Demographics, medical history, and surgical information were collected from the medical record. Statistical analysis was performed using Fisher's exact test for categorical comparisons and independent t-tests for continuous comparisons.

RESULTS: A total of 140 patients were identified and contacted. Three patients declined participation and one could not be reached. Most patients (92.7%) were satisfied (n = 67) or very satisfied (n = 48) with postoperative phone visits. Forty-four patients (32.4%) preferred in-person visits, while 96 patients (67.6%) felt telehealth was sufficient. The most common reason for keeping in-person visits was a desire to have physical concerns evaluated. Decreased satisfaction with telehealth follow-up was significantly correlated with higher Charlson Comorbidity index.

DISCUSSION & CONCLUSION: This is the first study to evaluate patient satisfaction with telehealth follow-up after total joint replacement within a [institution blinded for review] system. Our findings support the use of telehealth as an alternative to in-person follow-up at 6 to 12 months post total joint arthroplasty. Our findings also suggest that patients with certain health profiles and physical concerns may be better served with in-person visits. Overall, telehealth provided most patients who were 6 to 12 months post total joint arthroplasty with a favorable experience based on greater convenience and access to care.

Paper 59

Telehealth Utilization and Perspectives Among Orthopedic Surgeons

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BACKGROUND: In the midst of the COVID-19 pandemic, many healthcare systems and providers have turned to telehealth. In response to guidelines for social distancing, new policies were created to allow for expansion of and reimbursement for virtual medicine, expanded scope of practice, and relaxed regulations to allow providers to practice across state lines. The purpose of this study was to assess the current utilization and perspectives on telehealth among orthopedic providers throughout the state of Florida.

METHODS: A telehealth survey was sent to all 710 Florida Orthopedic Society surgeon members in the state of Florida in June of 2020. This twenty-five-item survey was developed to assess providers use of telehealth using a combination of multiple choice, Likert scaled, and open-ended question to assess utilization, efficacy, and perspectives on telehealth. In addition, demographic data and practice specific questions were also administered as part of the survey.

RESULTS: Of the providers who responded only 4.4% reported using telehealth regularly prior to the pandemic and 56.5% reported having never conducted a virtual visit prior to the pandemic. The majority of providers (73.9%) felt virtual visits were convenient for their patients and 52.2% of providers felt virtual visits were more convenient for their own practices. Only 4% indicated preference for virtual visits over in-person visits but 78.3% of providers agreed that virtual visits bring value to their practice by allowing them to see patients who would otherwise be unable to attend in-person appointments. A majority of providers (86.36%) reported that virtual visits were best suited for follow-ups and <10% indicated telehealth was an adequate tool for new patient visits. Only 19% of providers felt that it was difficult to use virtual visit technology and 60.9% reported using a full telehealth platform. Of the providers, 60.9% reported they will likely conduct more virtual visits in the future should the reimbursement policies continue to be profitable.

CONCLUSION: With the removal of telehealth restrictions related to reimbursement policies, HIPAA restrictions, and technologic limitations, it appears that orthopedic surgeons successfully integrated telehealth into their practices during the COVID-19 pandemic and believe there was improved convenience to both physicians and patients. Majority of providers felt virtual visits were optimal to integrate for follow up visits with their patients and most used a full telehealth platform to conduct these visits. Though the value of telehealth in orthopedics is promising, there are significant barriers to overcome before telehealth becomes a long-term player in orthopedics.

Paper 60

Does Medicaid Insurance Status Affect Access to Orthopedic Care?

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INTRODUCTION: Medicaid patients are known to have limited access to health services compared to privately insured patients, particularly with subspecialty providers such as orthopedic surgeons. Evidence demonstrates even in states with expanded Medicaid, Medicaid patients are less likely or delayed in obtaining an orthopedic appointment compared to private and Medicare patients. Medicaid expansion may have a negative impact on an orthopedic practice and may not increase access to care. The purpose of this study is to evaluate the impact of Medicaid vs. low-income uninsured access to orthopedic care in South Florida.

METHODS: The AAOS directory was queried with the most populous zip codes in Palm Beach County, Broward County, and Miami-Dade County. A random number generator was utilized to select orthopedic clinics from each county. An appointment was requested for the caller's fictitious 55-year-old mother complaining of left knee pain. Each office was called three times to assess the response to three insurance status (private insurance, Medicaid, and no insurance). Response data collected included whether an appointment was given based on insurance type and number of business days until earliest available appointment. Calls were repeated to each clinic with a waiting period of 2 weeks to avoid caller recognition.

RESULTS: Of the 64 orthopedics clinics contacted, 37 answered the calls directly with one clinic not accepting new patients. All (100%) of the privately insured patients and uninsured patients were able to make an appointment, while only 13.3% of Medicaid patients were able to schedule an appointment ($p < 0.01$). There was no significant difference found between insurance status and waiting time in business days to the earliest available appointment ($p = 0.39$); the difference between Medicaid acceptance across counties was also not significant ($p = 0.32$). Medicaid patients were significantly more likely to be denied a new patient appointment compared to Florida Blue and uninsured patients ($p = 0.03$).

CONCLUSION: Patients with Medicaid have reduced access to orthopedic services compared to privately insured patients and uninsured patients. When considering Florida's recent decision not to expand Medicaid, the current data reflects that a potential Medicaid expansion would not increase patients' access to orthopedic care. Uninsured patients do not appear to experience similar barriers to access orthopedic care; however, this current study does not account for potential prohibitive costs for these uninsured patients that Medicaid may cover.

Paper 61

Osteosarcoma Incidence and Overall Survival Rates from 1975 to 2018: Have We Really Improved?

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OBJECTIVE: The overall survival of osteosarcoma has increased over the years, primarily attributed to the introduction of chemotherapy. Previous studies have reported a plateau of survival rates, with no significant improvement since the mid-1980s-1990s. However, there has been a lack of reported incidence and survival rates over the 15 years. Therefore, an update, with more recent time periods, is welcome. The purpose of this study is to update the incidence and overall survival of osteosarcoma utilizing a validated large national database.

METHODS: A total of 5,551 patients diagnosed with osteosarcoma from the National Cancer Institute's population-based Surveillance, Epidemiology, and End Results program between 1975 and 2018 were collected. The incidence, patient characteristics, and overall survival rates were collected from the SEER database. Sub-analysis based on age, year of diagnosis, sex, disease sequence, and stage were performed.

RESULTS: Based on data from 1975 to 2018, the incidence of osteosarcoma followed a bimodal distribution, with the first peak at 15-19 years of age (8.2 cases/million) and a second peak at 75-79 years of age (4.6 cases/million). The annual incidence of osteosarcoma increased in patients aged 0-24 from 3.9 (1975-1982) to 5.3 (2013-2017) (Annual Percent Change [APC] = 0.6; 95% CI 0.2-1, $p < 0.05$). During this same time period, the annual incidence also increased from 4.0 to 5.9 cases/million (APC = 0.7; 95% CI, 0.1-1.3, $p < 0.05$) among males less than 24 years of age, however, there was no significant change among age matched females (APC = 0.3; 95% CI, -0.2-0.8).

From the 1970s to the mid-1990s, survival improved markedly. Five-year survival among patients with local disease improved between 1983-92 and 2013-17 (69.2% vs. 78.6%, $p < 0.04$) while the 5-year relative survival in distant disease significantly improved (12.2% vs. 26.2%, $p < 0.02$). Among patients receiving chemotherapy, there was a marked increase in survival from 1975-80 and 1986-90 (34.6% vs. 59.2%, $p < 0.01$), though there has been minimal change as of 2011-15 (60.8%).

CONCLUSION: This population-based descriptive large-database study provides the current incidence and survival rates of osteosarcoma. While the overall incidence of osteosarcoma has remained relatively stable since 1990, there has been a significant increase among males age 0-24 years. From the 1970s to the mid-1990s, osteosarcoma survival significantly improved, with a more gradual, although significant, increase since then. In recent years, chemotherapy has continued to improve survival in patients with distant disease. The overall impact of osteosarcoma will continue to be revealed with the continued expansion of collaborative databases and accurate recording.

Paper 62

Transcutaneous Oxygen as a Predictor of Wound Healing Complications in Preoperatively Radiated Soft Tissue Sarcoma

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BACKGROUND: While there are advantages of preoperative radiation in soft tissue sarcoma, there are negative consequences with regard to healing of the surgical wound. An estimated 43% with lower extremity tumors treated with preoperative radiation will experience complications. We hypothesized skin oxygenation at the incision would correlate with wound complications.

PATIENTS & METHODS: This study was designed as a prospective, multi-institutional cohort. Inclusion criteria were a biopsy proven soft-tissue sarcoma of the lower extremity with plan for preoperative radiation followed by limb-sparing resection. Transcutaneous oxygen (TcO₂) measurements of the surgical field were obtained at three time points prior to surgery. The primary outcome was wound healing at 6 months after resection. Secondary outcome was PROMIS Global Health and Musculoskeletal Tumor Society (MSTS) scores at 3 and 6 months. Continuous variables were summarized using medians and interquartile ranges. Categorical variables were summarized using counts and percentages. Statistical significance considered at $p < 0.05$.

RESULTS: 43 patients were enrolled. Four patients were ultimately excluded, leaving a total of 39 patients with a mean age of 65.5 years for analysis. 18 of 39 patients (46.2%) experienced a wound complication. We observed higher skin oxygenation in patients without complications, although not statistically significant. Outcome scores were significantly decreased in the patients with a complication at 3 months, but not at 6 months.

CONCLUSION: TcO₂ was decreased, though statistically insignificant, in patients with healing complications. Functional outcomes were temporarily decreased in patients with a healing complication, demonstrating the clinical relevance of this problem. While the TcO₂ may have utility, it was unable to discern wounds at risk due to incomplete sampling of the surgical site.

Paper 63

Adjuvant Radiation after Resection of Atypical Lipomatous Tumors is Associated with Improved Local Control but Increased Complications: A Multicenter Evaluation

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BACKGROUND: The use of adjuvant radiation therapy after resection of atypical lipomatous tumors in the extremity is controversial. An assessment of both local control and complications has yet to be performed.

QUESTION/PURPOSE: What is the local recurrence and complication rate after first time resection of atypical lipomatous tumors of the extremity and trunk with and without adjuvant radiation?

PATIENTS & METHODS: A retrospective study was performed on patients treated from 2005-2020 with surgical resection of a histologically proven atypical lipomatous tumor of the extremity or trunk at two sarcoma centers. In total, 104 patients underwent adjuvant radiation (XRT), and 87 patients were treated with surgery alone (no-XRT). All patients had a minimum of three months follow-up and complications were compared. Local recurrence and time to recurrence was compared in 136 patients (93 XRT, 43 no-XRT) with at least 2 years follow-up. Wilcoxon rank-sum and chi-square tests compared continuous and categorical variables, respectively. Logistic regression identified association between patient, tumor, and treatment variables with recurrence and complications.

RESULTS: In patients with >2 years follow up, there was a 40% recurrence rate in the no-XRT group and a 1% recurrence rate in the XRT group ($P < 0.01$). Time to recurrence was 8.2 years in the no-XRT group and 4.7 years in the XRT group. Tumors that received radiation were larger (19 cm vs. 15 cm, $P = 0.04$) and more often deep to fascia (96% vs. 84%; $P = 0.04$).

For all patients, there was a 23% complication rate in the no-XRT group and a 67% complication rate in the XRT group ($P < 0.01$). Time to surgical intervention from complication was 0.75 months in the no-XRT group and 26 months in the XRT group. Most common complication in the XRT group was lymphedema (41%). Fracture or osteonecrosis occurred in 5 patients (5%) who received XRT ($P = 0.06$). Greater tumor size was associated with increased risk of complications in multivariable analysis (OR 1.08, 95% CI (1.04, 1.13); $P < 0.01$).

CONCLUSION: Adjuvant radiation after resection of atypical lipomatous tumors of the extremity and trunk is associated with forty times reduced local recurrence rate and three times increased complication rate. Radiotherapy should be carefully considered on an individual basis based on these risks and benefits.

Paper 64

Venous Thromboembolism Following Upper Extremity Orthopedic Surgery for Metastatic Bone Disease

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BACKGROUND: Upper extremity (UE) procedures are considered low risk for venous thromboembolism (VTE) and prophylaxis is typically not prescribed. However, the risk of VTE in metastatic bone disease (MBD) patients may be higher due to a hypercoagulable state secondary to tumor metastasis. Pathologic fracture may also increase risk due to the acute exposure of tumor material to the bloodstream. The aim of this study is to determine whether MBD and pathologic fracture are associated with an increased risk of VTE after UE procedures.

PATIENTS & METHODS: The M30 Orthopedic Dataset from PearlDiver was used to identify patients with CPT codes for shoulder arthroplasty and humerus ORIF or IM nailing between 2010 – 2019. The cohort was divided by the presence or absence of MBD and matched by age, gender, and comorbidities. Finally, all MBD patients were divided by the presence or absence of pathologic fracture.

RESULTS: 1,082 MBD patients and 1,082 controls were included in the matched cohort analysis. MBD was associated with a higher cumulative risk of VTE at all time points ($p < 0.0001$).

CONCLUSION: Approximately 1 in 6 MBD patients with a pathologic fracture will develop a VTE in the first 90 days after surgery. This study provides strong evidence to support the use of VTE prophylaxis in MBD patients undergoing an upper extremity procedure. Further study is needed to establish specific guidelines for VTE prophylaxis regimens in this population.

Paper 65

Edward D. Henderson, M.D. Award Presentation | Surgical Treatment of Anterior Cruciate Ligament Tears in Competitive Wrestlers: Reoperations, Outcomes, and Return to Play

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INTRODUCTION: Wrestling is a physically demanding sport with young athletes prone to anterior cruciate ligament (ACL) injuries that often necessitate surgery. However, there is a paucity of data evaluating the results of ACL reconstruction (ACLR) in competitive wrestlers. The purpose of this study was to assess return to play (RTP), patient-reported outcomes, reoperation rates, and graft survival following ACLR in a large cohort of competitive wrestlers.

METHODS: All competitive wrestlers (high school, collegiate, or professional leagues) with a history of an ACL injury and subsequent reconstruction at a single institution between 2000 and 2019 were retrospectively identified. Graft failure was defined as a re-tear determined by a combination of clinical evaluation, advanced imaging examination, or undergoing a revision ACL reconstruction. All patients were contacted for determination of reinjury rates, current sport status, visual analog scale (VAS), international Knee documentation Committee (IKDC), and Tegner activity scores.

RESULTS: 118 knees in 114 patients met final inclusion criteria at a median follow-up time of 5.8 years (IQR: 3.6 – 10.3). ACLR was most often performed with bone-patellar tendon-bone (BTB) autograft (n = 64; 54%) or hamstring tendon (HT) autograft (n = 43; 36%). At final follow-up, 86% of wrestlers were able to return to sport, but only 80% were able to return to competitive wrestling at a median of 273 days (IQR: 203 – 379) after the index procedure. Graft failure occurred in 17 (14%) patients at a median time of 1.4 years (IQR: 0.8 – 4.7) after the index ACLR. BTB autograft demonstrated lower failure rate compared to HT autograft (8% vs. 21%; P = 0.044). Kaplan-Meier survivorship free from graft failure for the entire cohort was 95.3% at 1 year, 92.5% at 2 years, 89.8% at 5 years, 84.6 at 10 years, 77.6 at 20 years. BTB autograft was associated with better survival than HT autograft up to 15 years after index ACLR (90.4% vs. 76.3%; P = 0.030).

CONCLUSION: Anterior cruciate ligament reconstruction improved patient-reported outcomes and activity levels in wrestlers at mid-term follow-up. Return to competitive wrestling was observed in 80% of athletes at a median of 9 months after ACLR. Unique challenges still exist in this cohort with 14% of athletes experiencing graft failure. Additionally, BTB autograft reconstruction may serve as a more durable graft for competitive wrestlers with lower rates of failure when compared to HT autograft even up to 15 years after surgery.

Paper 66

E. W. Johnson, Jr., M.D. Award Presentation | Spinal Anesthesia vs. General Anesthesia in Contemporary Primary Total Hip Arthroplasties

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Rebecca L. Johnson, M.D. / Rochester, MN
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INTRODUCTION: Spinal anesthesia (SA) has seen increased utilization in contemporary total hip arthroplasties (THAs). However, the benefits of SA in comparison to general endotracheal anesthesia (GETA) are not fully understood. This study aimed to investigate the pain control, length of stay (LOS), and complications associated with modern SA vs. GETA in primary THAs utilizing a cohort of patients from a large, high-volume academic center.

METHODS: We retrospectively identified 13,730 primary THAs (11,319 patients) from 2000 to 2016 using our institutional total joint registry. Of these cases, 58% had GETA and 42% had SA. Baseline characteristics between groups were similar with mean age of 64 years, 51% female, and mean body mass index (BMI) of 30 kg/m². Pain was assessed by oral morphine equivalents (OMEs) and numeric pain scale (NPS) scores. Complications including readmissions and venous thromboembolisms (VTEs) were studied. Data were analyzed using an inverse probability of treatment weighted model based on propensity score that accounted for age, sex, BMI, ASA score, Charlson comorbidity index (CCI), operative diagnosis, operative time, year of surgery, and surgeon utilization of SA. Mean follow-up was six years.

RESULTS: Patients treated with SA had lower NPS scores ($p < 0.001$) and required fewer postoperative OMEs ($p < 0.001$). Patients treated with SA had shorter LOS ($p = 0.02$), fewer cases of altered mental status (AMS; OR 1.4, $p = 0.02$), and fewer intensive care unit admissions (ICU; OR 1.4, $p = 0.01$). There was no difference in the incidence VTEs ($p = 0.8$), 30-day readmissions ($p = 0.17$), or 90-day readmissions ($p = 0.18$).

DISCUSSION: In this large, single institution study, we found SA was associated with significantly reduced pain scores and OME use postoperatively. Additionally, SA resulted in reduced length of stay as well as fewer cases of AMS and ICU admissions. These data favor the use of SA in contemporary primary THAs.

SUMMARY: Spinal anesthesia was associated with lower pain scores, reduced OME requirements, fewer cases of AMS, and shorter hospital LOS when utilized in contemporary primary total hip arthroplasties.

Paper 67

Carl L. Nelson, M.D. Award Presentation | Impact of Registry Education on Opioid Utilization: MARCQI's Pain-Control Optimization Pathway

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INTRODUCTION: Orthopedic providers routinely prescribe opioids for pain management after total joint arthroplasty (TJA). In 2019, the Michigan Arthroplasty Registry Collaborative Quality initiative (MARCQI) recommended an evidence-based opioid pain pathway to participating physicians and hospitals. The purpose of this study was to determine if the education could influence and have lasting effects on the prescribing patterns for TJA patients.

METHODS: Using the MARCQI total joint database, use of opioid medications was evaluated from January 2018 through December 2019. All primary total knee arthroplasties (TKA), total hip arthroplasties (THAs), unicompartmental knee arthroplasties, and hip conversion procedures were included. The number of oral morphine equivalents (OMEs) prescribed at discharge was collected and compared before and after July 2018 when opioid laws were implemented in Michigan as well as before and after the MARCQI recommendations were made in March 2019. The data compared THA and TKA patients, opioid-naïve vs. opioid-tolerant patients, individual surgeons, and MARCQI sites.

RESULTS: The data included 84,998 TJAs: 22,774 opioid-naïve THAs, 9,124 opioid-tolerant THAs, 40,882 opioid-naïve TKAs, and 12,218 opioid-tolerant TKAs. In all groups and at all time periods there was a significant decrease in prescriptions ($p < 0.001$). Individual surgeons and participating sites also demonstrated decreased OMEs on discharge after the recommendations. Between the first and last months of collection, this represented an overall decrease of opioid OMEs for THA by 47.1% for opioid-naïve patients and 53.4% for opioid-tolerant patients. For TKA patients, the OME decrease was 48.3% for opioid-naïve patients, and 48.4% for opioid-tolerant patients.

CONCLUSION: The MARCQI POP program has been successful in drastically reducing opioid prescribing with lasting effects, which in turn has substantially limited the overall opioid prescription burden in the State of Michigan for patients undergoing arthroplasty.

Paper 68

Dallas B. Phemister, M.D. Award Presentation | Depth of Tissue Necrosis and Cell Viability
Following Treatment with Arthroscopic Radiofrequency Wand

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Meredith Herman, M.S. / East Lansing, MI
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Adequate blood supply is essential for successful tendon-to-bone healing following a rotator cuff repair. Since the tendons are relatively hypovascular, the underlying bone bed contributes a significant portion of the repair's perfusion. Thus, it is imperative that footprint preparation techniques expose the underlying bone without comprising the adjacent vasculature and osteocytes. This study aims to explore the histological depth of tissue necrosis caused by common footprint preparation techniques using mechanical shaving and radiofrequency ablation.

Six bovine metacarpal bones were collected one hour after devascularization and submerged in normal saline. Footprints were created by radiofrequency ablation wand, at both the coagulation and ablation settings, and a mechanical shaver. Preparation was performed at 5 and 15 seconds. After the specimens were processed and prepared as hematoxylin and eosin-stained microscopic slides, each footprint was evaluated microscopically. Depth of tissue destruction, preservation of periosteum, and osteocyte necrosis were evaluated histologically compared to the control sections for each treatment method.

There was no significant difference in depth of soft tissue destruction between the mechanical shaver and 15 seconds of coagulation (1.25 mm vs. 1.5 mm; $P = .559$), but the difference between coagulation and ablation was significant at both 5 seconds and 15 seconds (0.67 mm vs. 2.3 mm; $P = .001$ and 1.5 mm vs. 3.58 mm; $P = .012$). While the depth of soft tissue destruction increased with time, the difference between 5 and 15 seconds for either treatment was not significant (0.67 mm vs. 1.5 mm; $P = .088$, 2.3 mm vs. 3.58 mm; $P = .051$). The periosteum was rarely breached by any treatment and was seen to be well preserved in most sections. Osteocytes remained viable in the central area of treatment, and the normal cortical bone architecture was maintained. Compared to the control bone sections there was one section treated with ablation for 15 seconds that showed complete loss of overlying soft tissue in the treatment area.

When used appropriately, radiofrequency ablation effectively debrides soft tissue from the rotator cuff footprint while preserving the underlying periosteal vasculature and cortical osteocytes. However, higher energy settings should be used with caution because the depth of tissue destruction removes the protective soft tissue layer, placing the periosteum and cortex at risk for injury with further radiofrequency exposure.

Breakout Session #6 (Foot and Ankle)
Friday, April 08, 2022

Paper 69

To BE(AR) Or Not To BE(AR) - Jones Dilemma?

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Ashish Shah, M.D. / Birmingham, AL

INTRODUCTION: Jones fracture (base of 5th metatarsal) is commonly encountered. Management is a subject of great debate with little consensus on postoperative weightbearing protocols. We aim to evaluate the efficacy of early weightbearing in the postoperative management of Jones fracture and assess its association with radiological union and patient reported outcomes.

METHODS: Patients that underwent fixation of Jones fracture from January 2011 to December 2020 were identified. Radiographic follow-up of at least 8 weeks was required (40 patients). Patients were grouped by early weightbearing (EWB) as tolerated and non-weightbearing (NWB) for 2 weeks followed by partial weightbearing. Medical records were reviewed for demographics, comorbidities, surgical construct, fracture type, mode of injury, and union. Delayed union was defined as lack of radiographic evidence of union at 12.5 weeks. Patients completed postoperative PROMIS physical function and pain interference as well as FFI scores.

RESULTS: The mean age was 42.83 ± 17.03 years with a female predominance ($n = 23$; 57.5%) and an average BMI of 32.2 ± 8.7 . 50% of the patients in EWB and 43% in NWB group experienced delayed radiological union (>12 weeks) and this did not differ by group. There was one nonunion in NWB and none in EWB. The number of wound complications did not vary by group. Seventeen patients completed postoperative FFI and PROMIS scores at a median of 40 months (41.5 IQR). The FFI and PROMIS scores did not differ by group. In the EWB group, the median PROMIS scores were physical function 43.7 (6.7 (IQR)) and pain interference 52.8 (10.1) compared to physical function 44.0 (11.6) and pain interference 55.2 (11.8) in NWB. The median total FFI score in EWB was 20.0 (27) compared to 32 (32) in NWB.

CONCLUSION: The EWB group exhibited comparable results to the NWB group after surgical fixation of Jones fracture. Importantly, PROMIS scores indicate both groups had comparable functional outcomes at long-term follow-up and were within a standard deviation of the general population of the United States (Score of 50 with SD of 10) for both pain and function. While further investigation is required, EWB may have equivocal results in terms of union, wound complications, and functional outcomes while allowing for early mobilization after Jones fracture fixation.

Paper 70

Diagnostic Accuracy of Weightbearing CT in Detecting Subtle Chronic Syndesmotic Instability: A Prospective Comparative Study

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The diagnostic gold-standard for subtle syndesmotic instability (SSI) is surgically invasive arthroscopic assessment. Weightbearing computed tomography (WBCT) provides a non-invasive alternative by utilizing distal tibiofibular syndesmotic (DTFS) area and volume measurements. No studies have assessed WBCT diagnostic accuracy for chronic SSI. The purpose of this study was to prospectively evaluate the diagnostic accuracy of WBCT measurements (compared to gold-standard arthroscopy) in patients with suspected SSI.

In this IRB-approved prospective comparative study, 11 patients with suspected SSI were enrolled. Patients were assessed preoperatively by bilateral standing WBCT. Raw 3D WBCT was automatically segmented by dedicated software. WBCT semi-automatic DTFS area and DTFS volumes were obtained. Threshold values for WBCT abnormality were defined based on currently available data. Subjects underwent surgical treatment including DTFS instability arthroscopic assessment, defined as positive when a 3 mm diameter sphere could enter the syndesmotic incisura. WBCT measurement sensitivity, specificity, positive and negative predictive values, and accuracy were calculated using confirmed arthroscopic instability. Paired t-tests/Wilcoxon analysis was used to compare measurements ($P < 0.05$).

Compared to non-injured sides, DTFS area and volumes were significantly higher in injured ankles at 1cm (667 vs. 554 mm³) and 3cm (2331 vs. 2038 mm³). Medial gutter volumes were also increased (398 vs. 370 mm³). DTFS volumes at 5cm and lateral gutter volumes were not different. 9/11 patients had confirmed arthroscopic DTFS instability. Considering WBCT area measurements, 4/11 patients were found to be positive(> 105 mm²), including 3 true positives (+WBCT/+Arthroscopy), 1 false positive (+WBCT/-Arthroscopy), 6 false negatives (- WBCT/+Arthroscopy), and 1 true negative (-WBCT/-Arthroscopy), leading to a 33.3% sensitivity, 50% specificity, 75% PPV 75%, 14.3% NPV and 36% accuracy. When analyzing WBCT DTFS volumes(1cm), 3/11 patients were found positive(>796 mm³), depicting 3 true positives, 0 false positives, 2 true negatives and 6 false negatives, with resultant diagnostic accuracy of: 33.3% sensitivity, 100% specificity, 100% PPV, 25% NPV 25%, and 45% accuracy.

This is the first study to prospectively assess WBCT diagnostic accuracy of area and volume measurements in detecting chronic SSI, comparing it to the arthroscopic diagnostic standard. Compared to the uninjured side, DTFS area and volumetric measurements significantly increased in injured sides of patients with suspected SSI, including medial gutter volumes, consistent with associated deltoid ligament instability. Diagnostic accuracy for WBCT measurements were lower than expected. Incorporating additional patients and introducing an external rotational stress may optimize WBCT diagnostic accuracy for chronic SSI.

Breakout Session #6 (Foot and Ankle)
Friday, April 08, 2022

Paper 71

Comparison of Medial And Dorsal Approach for Talonavicular Fusion: A Cadaver Study

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INTRODUCTION: Talonavicular (TN) joint arthrodesis is a common procedure for end stage arthritis. There are two common operative approaches used to expose the TN joint for articular preparation, the medial and dorsal. Classically, the medial approach has been the preferred method of TN joint fusion, but recent arguments have been made for the use of the dorsal approach. Articular surface preparation is a key tenant required for any joint fusion. To date, no physical preparation studies have been done to compare the two approaches in terms of articular surface preparation. Our study aims to compare the two approaches.

METHODS: Ten fresh frozen cadaver specimens were obtained. Fluoroscopic radiographs were used to rule out any pre-existing pathology of the talonavicular joint. Specimens were assigned to receive either a dorsal or medial operative approach to the talonavicular joint. After joint preparation, the talonavicular joint was disarticulated and the amount of articular surface preparation was recorded using ImageJ software.

RESULTS: A total of 8 male and 2 female specimens were utilized with an average age of 64.5 ± 13.1 . The dorsal approach had a higher average percentage of talar, navicular, and total talonavicular joint surface prepared. When examining joint surface area preparation regardless of approach used, the talar head was significantly less prepared than the navicular. The inter-observer correlation coefficient was excellent for both navicular and talar surface area prepared.

CONCLUSIONS: The amount of articular surface preparation in the dorsal approach was consistently higher on average. Given the high rate of nonunion in isolated talonavicular and triple arthrodesis, surgeons should be aware that the dorsal approach may offer an increased amount of articular surface preparation. Our study adds to the growing body of evidence supporting the investigation and use of the dorsal approach when attempting talonavicular arthrodesis.

Paper 72

Impact of Patient Resilience on Outcomes of Open Brostrom-Gould Lateral Ligament Repair

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INTRODUCTION: Little is known about the factors affecting the intermediate outcomes of the Brostrom-Gould repair as measured by new patient reported outcomes instruments and the impact of patient resilience on postoperative outcomes. This is the first study to investigate the impact of resilience on the outcomes of lateral ligament repair.

METHODS: Retrospectively, 173 patients undergoing Brostrom-Gould at a single institution from January 2013 to June 2020 were identified. Patient characteristics, participation in athletic activities, operative variables, and complications were recorded. PROMIS Pain Interference v1.1 (PI), Physical Function v1.2 (PF), and FAAM were collected. The Brief Resilience Scale was used to quantify resilience. A linear regression model was constructed to evaluate the independent effect of resilience on each PROMIS and FAAM outcome instrument. Variables were included in the regression model based on an a-priori significance threshold of $p < .05$ in bivariate analysis.

RESULTS: Resilience's independent effect on outcome measures was as follows: PROMIS PF (Unstandardized β 8.2, 95% CI 3.9 to 12.6), PROMIS PI (Unstandardized β -4.8, 95% CI -7.9 to -1.7), FAAM Activities of Daily Living (Unstandardized β 16.6, 95% CI 8.7 to 24.6), and FAAM Sports (Unstandardized β 28.4, 95% CI 15.9 to 40.9). Preoperative participation in athletic activities also had a positive independent effect on multiple outcomes metrics including: PROMIS PF (Unstandardized β 9.4, 95% CI 2.8 to 16.0), PROMIS PI (Unstandardized β -5.3, 95% CI -10.0 to -.582), and FAAM Sports scores (Unstandardized β 34.4, 95% CI 15.4 to 53.4).

CONCLUSIONS: Resilience and patient participation in athletic activities are independent predictors of improved postoperative functional outcomes as measured by PROMIS and FAAM instruments at intermediate term follow-up. Resilient patients and athletes reported significantly higher physical function and less pain burden postoperatively. Preoperative quantification of resilience could enable improved prognostication of patients undergoing lateral ligament repair of the ankle.

Paper 73

Does BMI Affect Intermediate Outcomes of Open Brostrom-Gould Repair?

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INTRODUCTION: High BMI is a known risk factor for development of CAI and intraarticular pathology, but few studies have examined BMI's impact of the outcomes of lateral ligament reconstruction. The open Brostrom-Gould reconstruction, an anatomic repair, is the gold standard for repair of the lateral ligamentous complex. We aim to evaluation the impact of BMI on patient reported outcomes after open Brostrom-Gould repair.

METHODS: A total of 201 patients who underwent open Brostrom-Gould Repair were identified using CPT code. Patients undergoing repair for acute ligamentous injury were excluded. A completed telephonic survey was required for inclusion yielding 92 patients. The telephone survey included: PROMIS Physical Function (PF), Pain Interference (PI), and Depression domains(D) and the Foot and Ankle Ability Measure (FAAM). Medical records were examined for patient characteristics, operative variables, and complications. Patients were grouped by BMI <30 and BMI >30.

RESULTS: A total of 28 males (30%) and 61 females (69%) were included in this study. The average time at completion of survey was 4.1 years (standard deviation of 2.8). The median age was 44 with an interquartile range (IQR) of 20, while the median BMI was 31.5 with an IQR of 13.4. Obese patients had significantly worse PROMIS PF (Median 44.5 IQR 7.4 vs. median 48 IQR 16.5) and FAAM Activity of Daily Living subscale scores (Median 61.6 IQR 30.0 vs. median 82.7 IQR .36). Patients' FAAM self-reported overall level of function was significantly lower in obese patients (Median 70.0 IQR 20.0 vs. median 85 IQR 29). The BMI groups did not vary by other PROMIS domains or FAAM subscales.

DISCUSSION & CONCLUSION: At intermediate term follow-up, Obese patients report significantly worse physical function after open Bostrom-Gould repair compared to non-obese patients. Surgeons should be aware of this when prognosticating the outcomes of anatomic ankle reconstruction.

Paper 74

Predictors of Deformity In Patients with Progressive Collapsing Foot Deformity and Valgus of the Ankle

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BACKGROUND: Markers used for diagnosis and severity grading are well studied in patients with Progressive Collapsing Foot Deformity (PCFD). Medial facet subluxation (MFS) in weightbearing computerized tomography (WBCT) has been established as an early indicator of peritalar subluxation (PTS). When the disease affects the ankle leading to a valgus talar tilt (class E), structures distal to this topography may behave differently as they try to compensate proximal deformity. The aim of this study is to assess predictors of deformity in PCFD patients with and without valgus of the ankle. Our hypothesis is that MFS cannot be used in Class E patients as an accurate marker for evaluation and staging of PCFD.

METHODS: In this IRB-approved retrospective case-control study we analyzed WBCT imaging of 21 consecutive patients with PCFD with valgus of the ankle and 64 controls (flexible PCFD without ankle involvement). MFS (defined by percentage of uncoverage), middle facet incongruence angle, middle cuneiform-to-floor distance, forefoot arch angle, talonavicular uncoverage angle, hindfoot moment arm (HMA), Foot and Ankle offset (FAO) and talar tilt angle (TTA) were obtained and compared between groups using one-way ANOVA. A multivariate regression analysis was performed to evaluate which of the measurements influenced the alignment. A partition prediction model was constructed to assess how the variables contributed to the deformity. P values <0.05 indicated statistical significance.

RESULTS: Differences between groups was found for MFS, HMA, FAO, and TTA with a lower mean value of MFS in PCFD patients with valgus of the ankle. An inverse relation between MFS and TTA was found, which was demonstrated by an increase in the talar tilt and decrease in middle facet uncoverage. FAO values were affected by MFS in the control group (R^2 : 0.25) but not in the ankle valgus group (R^2 : 0.001), which was influenced mainly by the TTA (R^2 : 0.53). Additionally, a FAO value higher than 12.14 was found to be a strong predictor of deformity at the ankle.

CONCLUSION: MFS was lower in patients with PCFD and valgus of the ankle (Class E), which demonstrates that MFS is a weak predictor of deformity severity. Therefore, the talar tilt angle and Foot and Ankle offset should be used as disease markers in this group of patients. Furthermore, a FAO value above 12.14 may be an indicator of ankle involvement in PCFD patients.

Paper 75

Evaluating Prospective Patient-Reported Pain and Function Outcomes after Ankle and Hindfoot Arthrodesis

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BACKGROUND: Hindfoot and ankle fusions are mechanically limiting procedures for patients. However, patient-reported outcomes of these procedures have not been well-studied. This study assessed outcomes of hindfoot and ankle fusions by using Patient-Reported Outcome Measurement Information System (PROMIS) Physical Function (PF) and Pain Interference (PI) Computer Adaptive Tests (CATs).

METHODS: Between 2014 and 2018, 102 patients were prospectively enrolled after presenting to a tertiary care facility for ankle and hindfoot fusions, including tibiotalar, tibiotalarcalcaneal, subtalar, and triple arthrodeses. Study participants completed preoperative and 12-month postoperative PF and PI CATs. The differences between mean 12-month postoperative and preoperative PROMIS PF and PI T-scores were analyzed with paired t-tests. The relationship between the 12-month PF and PI differences for the overall sample and patient factors was examined using multiple regression modeling.

RESULTS: The sample had mean age of 57.69 years, 48% were male, and 55% were obese. Patients who underwent ankle and hindfoot arthrodesis had statistically significant improvements from preoperative to 12 months postoperative in mean PF (36.26 ± 7.85 vs. 39.38 ± 6.46 , $p = 0.03$) and PI (61.07 ± 7.75 vs. 56.62 ± 9.81 , $p = 0.02$). Triple arthrodesis saw the greatest increases in physical function ($\Delta PF = 7.22 \pm 7.31$, $p = 0.01$) and reductions in pain ($\Delta PI = -9.17 \pm 8.31$, $p = 0.01$), achieving minimal clinically important difference (MCID). Patients who underwent tibiotalar fusion had significant improvements in physical function ($\Delta PF = 4.18 \pm 5.68$, $p = 0.04$) and pain reduction that approached statistical significance ($\Delta PI = -6.24 \pm 8.50$, $p = 0.09$), achieving MCID. Older age (≥ 60 years old) was associated with greater improvements in PF ($\beta = 0.20$, $p = 0.07$) and PI ($\beta = -0.29$, $p = 0.04$). Preoperative PF and PI T-scores were significantly associated with the 12-month change in PF and PI T-scores, respectively ($\beta = -0.74$, $p < 0.01$; $\beta = -0.61$, $p < 0.01$).

CONCLUSION: Hindfoot and ankle fusions are procedures with favorable patient outcomes leading to increased physical function and decreased pain at 12 months postoperative relative to preoperative.

LEVEL OF EVIDENCE: Level II

Paper 76

Quantifying Ankle Arthritis using a 3D Hounsfield Unit (HU) Weight-Bearing Computed Tomography (WBCT) Algorithm

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PURPOSE: To develop a software algorithm to quantify arthritis severity using 3D WBCT HU distributions.

METHODS: In this case-control study, we analyzed 20 patients with ankle arthritis (10 mild, 10 severe) and 10 controls that underwent WBCT of the foot and ankle. For each ankle, a 20x20x20 mm cubic volume of interest was defined and centered within the tibiotalar joint space. Within the cube, four linear projections perpendicular to the articular surface of the distal tibia were selected to sample the entire HU distribution within that line. Each line collected HU data across the transition of distal tibial cancellous and subchondral bone, the joint space, and talar subchondral and cancellous bone, in that order. The intensity profiles were recorded and graphical plots of the HU distributions were generated for each line. These plots were used to calculate the joint space width (JSW) and HU contrast. JSW was defined as the distance between the maximum values within the HU intensity profiles. HU contrast was defined as $(I_{\text{max,avg}} - I_{\text{min}}) / (I_{\text{max,avg}} + I_{\text{min}}) * 100$, where $I_{\text{max,avg}}$ is the average of the two maximum intensity points (subchondral bone), and I_{min} is the minimum intensity (joint space). JSW and HU contrast were compared between arthritic ankles and controls. Significance was considered for p-values <0.05 using Student's t-test for each pair.

RESULTS: The average JSW was 3.89 mm [95%CI: 3.29-4.48] for control, 3.24 mm [2.65-3.84] for mild arthritis, and 1.76 mm [1.16-2.36] for severe arthritis. Results were significant for control vs. severe ($p < 0.0001$), mild vs. severe ($p = 0.0011$) but not control vs. mild ($p = 0.13$). The average contrast was 70.3 [95%CI: 56.5-84.1] for control, 74.6 [60.8-88.4] for mild arthritis, and 35.5 [21.7-49.3] for severe arthritis. Results were significant for control vs. severe ($p = 0.0003$), mild vs. severe ($p = 0.0009$) but not control vs. mild ($p = 0.66$). Of note, multiple projections in the severe arthritis cases had JSW and contrast values of 0 due to complete joint space loss.

CONCLUSIONS: We present here a quantitative assessment of arthritis and JSW using HU projections. We found significant differences between severely arthritic ankles and controls. Since quantitative, software-based measurements are more reliable than qualitative evaluations, this method may serve as a starting point for the development of a more robust osteoarthritis classification system.

Paper 77

MTP Arthrodesis: Percutaneous Interfragmentary Screw Placement And Nerve Injury

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INTRODUCTION: Iatrogenic cutaneous nerve injury is the most common complication encountered in foot and ankle surgery with limited evidence to inform surgeons on neuroprotective techniques. The purpose of this study was to assess risk for injury to the dorsomedial cutaneous nerve (DCN) during insertion of percutaneous interfragmentary screws used in metatarsophalangeal (MTP) arthrodesis.

METHODS: Ten mid-tibia fresh frozen cadaver specimens were obtained for this study. All cadavers were grossly and radiographically inspected for any evidence of existing pathology or prior operative intervention. Percutaneous placement of interfragmentary screw in both distal to proximal and proximal to distal fashion was performed. Only the skin was incised before reaming and screw placement. After screw placement, dissection of the great toe was conducted. The distance between the screws and the DCN was obtained. The DCN was also inspected for injury.

RESULTS: A total of 10 cadavers were included. The average age of our population was 64 (\pm 12.6). Males represented 80% of our included specimens. Injury to the DCN was not reported using the proximal to distal screw fixation. The mean distance from the dorsal cutaneous nerve using proximal to distal interfragmentary screw fixation was 7.45 ± 3.85 mm compared to 4.30 ± 2.71 mm in the distal to proximal screw. Distal to proximal screw fixation was associated with 10% risk of nerve injury with no nerve injuries occurring at the site of proximal to distal screws.

CONCLUSIONS: In our cadaver study, proximal to distal screw fixation seems to offer neuroprotection in the setting of MTP arthrodesis. The DCN is known to have many anatomic variants, and DCN injuries can be a pretext for painful neuroma formation. Surgeons should consider careful dissection to the joint capsule in effort to decrease the risk of neurologic injury when placing interfragmentary screws in MTP arthrodesis.

Paper 78

Surgical Correction of Peritalar Subluxation and Patient Reported Outcomes: a Prospective Comparative Outcome Study in Flexible Progressive Collapsing Foot Deformity

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INTRODUCTION: Peritalar subluxation (PTS) is a critical finding in Progressive Collapsing Foot Deformity (PCFD) with middle facet subluxation and sinus tarsi impingement being essential markers of progressive deformity. Weightbearing CT (WBCT) imaging and three-dimensional (3D) distance (DM) and coverage maps (CM) allow an accurate assessment of PTS markers across the entire peritalar surface. We aimed to assess the effectiveness of joint-sparing realignment in reducing PTS with correlation to patient-reported outcomes (PROs) for flexible PCFD. We hypothesized that treatment would significantly improve PTS markers, decreasing sinus tarsi impingement and middle facet subluxation, and that this would correlate with improved PROs.

METHODS: In this IRB-approved prospective and comparative study, 10 flexible PCFD patients underwent joint-sparing surgical realignment. WBCT was performed preoperatively and 3-months postoperatively. 3DDMs of the peritalar surface were generated, and coverage of the subtalar joint articular facets and sinus tarsi were assessed as PTS markers. Joint coverage was defined as the percentage of articular space where DMs were <5 mm. 3DCMs demonstrated areas of adequate joint interaction (blue), joint subluxation (pink), and impingement (red). PROs were evaluated preoperatively and at the latest follow-up (average 8.2 months).

RESULTS: Foot and Ankle offset significantly improved from 10.6% preoperatively to 3.1% postoperatively ($p = 0.0005$). Anterior facet joint coverage significantly improved (61.6%), with reduction in sinus tarsi coverage/impingement (-43.2%) ($p < 0.001$). Non-significant improvement was noted in middle (19.5%, $p = 0.08$) and posterior facet joint coverage (3.5%, $p = 0.06$). PROs improved significantly postoperatively, with the European Foot and Ankle Surgery (EFAS) Score increasing from 3.1 to 7.3 ($p = 0.02$) and the Foot Function index (FFI) improving from 71.5 to 48.7 ($p = 0.01$). Improvements in these scores significantly correlated with improvement in middle facet coverage ($R^2 0.89$, $p = 0.0154$) and anterior facet coverage ($R^2 0.80$, $p = 0.04$).

CONCLUSION: Our study was the first to evaluate WBCT 3DDMs in assessment of surgical correction of PTS in PCFD patients. We found significant improvements in subtalar joint anterior facet coverage and sinus tarsi impingement following surgical reconstruction, with significant improvements in middle and posterior facet joint coverage. Notably, improvements in middle and anterior facet coverage correlated significantly with improved PROs. Therefore, optimization of subtalar joint coverage and reduction of PTS are of vital importance for surgical treatment of PCFD.

Paper 79

Middle Facet Subluxation Correlation With Foot And Ankle Offset In The Assessment Of Progressive Collapsing Foot Deformity

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INTRODUCTION: Identifying markers of severity and progression in Progressive Collapsing Foot Deformity (PCFD) provides surgeons with critical information used in decision making. Subtalar middle facet subluxation (MFS), the percent under coverage of the talus in relation to its calcaneus counterpart, was recognized as a reliable marker in weightbearing computerized tomography (WBCT) for PCFD diagnosis. The Foot and Ankle offset (FAO), the relative position between the center of the ankle joint and the foot tripod, is a three-dimensional WBCT tool predictive of disease severity. Our objective is to assess the relationship between the amount of MFS and FAO in flexible PCFD patients.

METHODS: In this retrospective IRB-approved comparative study, a total of 56 individuals with PCFD (74 feet) who underwent WBCT for baseline assessment were analyzed. MFS was executed in the coronal-plane, at the midpoint (on sagittal-plane) of the middle facet. Dedicated software was utilized to perform the FAO. Interobserver agreement was quantified for MFS and FAO using intraclass correlation coefficient (ICC). Bivariate linear regression analysis was used to assess the relationship between MFS and FAO. A partition prediction model and multivariate analysis were utilized to assess influence of MFS measurements on FAO values and vice versa.

RESULTS: A total of 56 patients (74 feet) were included in the study. The ICCs for interobserver reliability was 0.87 for MFS and 0.95 for FAO. In a bivariate analysis, MFS and FAO were found to be significantly and linearly correlated ($P < 0.0001$, $R^2 0.26$). Foot Angle offset = $2.22 + 0.12 \times$ Medial Facet Subluxation (%). In multivariate analysis, FAO and body mass index (BMI) were significantly correlated with MFS (<0.001 and 0.02 , respectively). The partition prediction model demonstrated that an MFS of 27.5% was an important threshold for increased FAO, with FAO of $3.4\% \pm 2.4\%$ when MFS was below threshold and $8.0\% \pm 3.5\%$ when above threshold.

CONCLUSION: We found a positive linear correlation between MFS and FAO measurements. Our results are consistent with the idea that MFS is a reliable marker for PCFD diagnoses and severity, correlating well with the FAO. This data may support clinical decisions in PCFD patients. Also, BMI was found to be positively correlated with MFS. Future prospective and longitudinal studies are needed to confirm the findings of this study.

Paper 80

The Role of Transverse Tarsal Arch Collapse in Progressive Collapsing Foot Deformity

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INTRODUCTION: A study recently published in Nature by Dr. Venkadesan and colleagues demonstrated a previously unrecognized importance of the transverse tarsal arch of the foot (TTA). They showed that the TTA contributes more to the longitudinal stiffness of the foot than the extensively studied medial longitudinal arch (MLA). Moreover, they showed that the evolutionary development of the TTA may be correlated with the evolution of bipedalism as feet developed from flexible flatfeet to a more rigid arched foot.

Given this recent publication, the TTA may also play a role in pathogenesis of modern-day flatfeet, now called Progressive Collapsing Foot Deformity (PCFD). PCFD is mainly described as collapse of the MLA with no consideration of the TTA.

Therefore, the objective of this study was to assess the TTA in the PCFD population. We hypothesized that PCFD will present with TTA collapse in addition to the previously understood MLA collapse.

METHODS: A retrospective review was conducted for 34 feet, 16 with PCFD and 18 control feet. All measurements were performed using weightbearing CT scans. A novel measurement, the Transverse Arch Plantar Angle (TAPA), was developed to directly measure the TTA. Additionally, the curvature of the TTA was estimated using the equation provided in the abovementioned study. This equation utilizes foot width and length, third metatarsal thickness, and fourth metatarsal torsion to give a torsion-based estimate of the normalized curvature of the TTA.

RESULTS: PCFD and control groups were comparable for BMI, age, and gender.

There was a significant difference found between groups regarding the TAPA angle (PCFD $111.13^\circ \pm 11.29$, control 97.02 ± 5.88 , $p < 0.001$). In contrast, there was no difference found between groups regarding the torsion-based estimation of curvature of the TTA (PCFD 12.76 ± 4.62 , control 15.18 ± 5.42 , $p = 0.25$).

CONCLUSIONS: Our study shows a previously undescribed collapse of the TTA in the PCFD population when measured directly. The non-significant torsion-based results suggest the TTA collapse is due more to a soft tissue failure than an insufficient bone torsion. This newfound understanding of the importance of the TTA should be further explored in the assessment of PCFD.

Paper 81

Influence of Weight-Bearing Computed Tomography in the New Staging System of Progressive Collapsing Foot Deformity Classification

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BACKGROUND: A new classification system was proposed for evaluating Flatfoot, Progressive Collapsing Foot Deformity (PCFD) in which staging is supplemented by a system combining deformity classes and its flexibilities, using clinical and radiographic signs. The capacity of the weightbearing computed tomography (WBCT) in evaluating PCFD has been established. We hypothesized that evaluations considering WBCT would significantly change the new proposed PCFD classifications, portraying a different picture of the disease.

METHODS: This retrospective IRB-approved case-control diagnostic study evaluated 89 PCFD feet with different presentations. Three fellowship-trained foot and ankle surgeons performed chart reviews and CR evaluations, determining patient PCFD classification. After a two-week washout period, the sequence was randomized, and a new classification was executed using clinical data and WBCT assessment. One of the readers repeated the WBCT evaluation two weeks later for intrarater reliability purposes. Assessments included presence or absence of classes, such as hindfoot valgus (A), midfoot abduction/sinus tarsi impingement (B), medial column instability (C), subtalar joint subluxation/subfibular impingement (D), and ankle joint valgus (E) as well as flexibility (1) and rigidity (2) of existing deformities. Fleiss kappa was used for interrater and Cohen's kappa for intrarater agreements. Differences between studied groups were determined by distribution comparison.

RESULTS: Mean BMI (54.4+-17.1) and age (33.6+-7.6) were calculated. Interrater reliability was moderate (0.55) and intrarater was excellent (0.98). Evaluation using CR produced 22.8% of 1ABC, 13% of 1AC, 8.7% of 1ABCD, and 7% of 2EABCD as most prevalent classifications. WBCT assessment found 31.5% of 1ABC, 11.2% of 1ABCD, 10.1% of 2ABCDE, and 5.6% 1ABCDE. Class A was the most frequent component in CR (93.5%) and WBCT (94.5%). Class B had a higher prevalence in WBCT (94.38%) than in CR (71.7%) as well as Classes C (89.9% and 88.0%), D (44.9% and 29.3%), and E (31.5% and 23.9%). The percentage of combined flexible (1) and rigid (2) deformities was also higher in the WBCT evaluation (39.3% compared to 35.8%).

CONCLUSION: Combination of PCFD components could support clinical decisions, and proper identification of classes is mandatory for a complete diagnosis. WBCT showed a different rate of deformity recognition, which increased the incidence of all classes, especially B and D. An excellent intrarater agreement was found, which infers reliability of patient assessment combining clinical and WBCT evaluation. The obtained information could help providers enhance comprehension of the disease for patient care.

Paper 82

Comparison of Triamcinolone and Methylprednisolone Efficacy and Steroid Flare Reaction Rates in Shoulder Corticosteroid Injection: A Randomized Parallel Study

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BACKGROUND: Corticosteroid injections are used to reduce pain and inflammation for various shoulder pathologies. Corticosteroid flare reaction is a well-described phenomenon that, despite being self-limited, causes significant pain and dysfunction. Currently, there is a paucity of literature to drive the decision-making process between different corticosteroid medications. We compared the incidences of steroid flare reaction and 3-month efficacy following methylprednisolone acetate (MPA) and triamcinolone acetonide (TA) corticosteroid injections into the glenohumeral joint or subacromial space.

METHODS: This was a prospective, randomized parallel study. Injections were given into the glenohumeral joint or subacromial space by four fellowship-trained shoulder and elbow or sports medicine orthopedic surgeons utilizing standard sterile techniques. During the first 3-month block, MPA was used in all injections and the second 3-month block TA was given. Injections consisted of 2cc of Lidocaine, 2cc of Marcaine, and 80mg of either MPA or TA. Visual analog scale (VAS) pain scores were recorded immediately prior to injection, on days 1-7 post-injection, and at 3 months post-injection. The primary outcome was incidence of steroid flare reaction, defined as a post-injection increase of at least two points from baseline in the first week following injection. The secondary outcome was injection failure at three months post-injection. Injection failure was considered if VAS at 3 months was greater than baseline or the patients had proceeded with another injection or surgery.

RESULTS: 410 injections were given (199 MPA and 211 TA). Of these, 296 patients (72.2%) completed their first week of pain scores, with 153 and 143 patients in the MPA and TA cohorts respectively. Significantly more patients in the MPA cohort reported a flare reaction compared to the TA cohort (37, 24.2% vs. 7, 4.9%; $p < 0.001$) during the first post-injection week. A total of 329 patients (80.2%), 166 and 163 in the MPA and TA cohorts respectively, completed their 3-month survey. No significant difference was seen in rates of injection failure between MPA and TA (77, 46.4% vs 62, 38.0%; $p = 0.125$).

CONCLUSION: Corticosteroid shoulder injections with TA resulted in a 5-fold reduction of steroid flare reactions with similar 3-month efficacy rates compared to MPA injections. This study supports TA as a more viable corticosteroid selection for shoulder injections to treat shoulder pathology while minimizing risk of flare reaction compared to MPA.

LEVEL of EVIDENCE: Level II Treatment Study

Paper 83

Opioid-Sparing Pain Management Protocol Following Shoulder Arthroplasty Results in Less Opioid Consumption and Higher Satisfaction: A Prospective, Randomized Control Trial

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BACKGROUND: Recently, the opioid epidemic has been the center of focus for healthcare providers and governmental agencies due to rising rates of opioid abuse, opioid-related fatalities, and overall economic burden of treating the opioid epidemic. As orthopedic surgeons account for 7.7% of all dispensed opioid prescriptions within the United States, surgeons have migrated toward multimodal pain management strategies in controlling postoperative pain as well as limiting opioid use and opioid related complications. Currently, there remains no clear consensus on the ideal pain management strategy following shoulder arthroplasty and the vast majority are based around opioid-driven protocols.

METHODS: Patients undergoing primary anatomic or reverse total shoulder arthroplasty were prospectively enrolled and randomized into an opioid-sparing (OS) or a traditional opioid-based (OB) postoperative pain protocol. Both groups received opioid education, a periarticular injection with liposomal bupivacaine, and multimodal management including acetaminophen, celecoxib, and gabapentin. Patients in the OB group were given a prescription of 40 oxycodone tablets and standard icing whereas the OS group received ketorolac, continuous cryotherapy, and a prescription of 10 oxycodone tablets for rescue only. Patients were queried regarding their levels of pain and opioid consumption at days 1-7, 2-weeks, 6-weeks, and 12-weeks postoperatively. Patient satisfaction with pain management was recorded at 1-week, 2-week, 6-week, and 12-week time points. Range of motion (ROM), ASES score, and SANE score were assessed preoperatively and at 12 weeks postoperatively. Complications, readmissions, and reoperations were prospectively recorded.

RESULTS: A total of 78 patients were enrolled. No difference in VAS pain scores were seen at any time point between OB and OS groups. OS group consumed less oral morphine equivalents (OME) at all time points from inpatient hospitalization to 12-weeks postoperatively, ($p < 0.05$). Total OME consumption was reduced by 213% for OS vs. OB group (112 vs. 239; $p < 0.0001$). OS group consumed fewer opioid pain pills at all time points from day 1 to 12-weeks postoperatively, ($p < 0.05$). A 395% reduction in number of opioid pain pills consumed in first 12 weeks postoperatively was seen in OS vs. OB group (4.3 vs. 17.0; $p < 0.0001$). Significantly more patients in OS group were completely off opioids by 2 weeks postoperatively, (86.1% vs. 58.5%; $p = 0.011$) and 94.4% of OS group were off opioids by 6 weeks postoperatively. The OS group were more satisfied with pain management at 1-week and 6-week time points ($p = 0.05$). No difference in ROM, change from baseline in ASES or SANE scores, complications, readmissions, or reoperations were seen between groups.

CONCLUSIONS: The findings of this study determined the adoption of an opioid-sparing postoperative pain management protocol following shoulder arthroplasty results in a nearly 4-fold reduction in opioid pain pill consumption and earlier cessation of opioids. In addition, patients reported higher satisfaction with their pain management protocol.

Paper 84

Antibiotic Prophylaxis with Cefazolin is Associated with Lower Shoulder Periprosthetic Joint Infection Rates than Non-Cefazolin Alternatives

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BACKGROUND: Prosthetic joint infection (PJI) is a devastating and common reason for surgical revision after shoulder arthroplasty (SA). Prophylactic antibiotics are the standard of care; however, data regarding the comparative efficacy of specific antibiotics in the prevention of shoulder PJI remains limited. This study sought to determine whether perioperative antibiotic choice affects rates of PJI development in SA.

METHODS: From 2000 and 2019, all primary SA types (hemiarthroplasty, anatomic total shoulder arthroplasty, reverse shoulder arthroplasty) performed for elective and trauma indications with perioperative antibiotic data and a minimum of 2-year follow-up were identified from a single institution. Demographics, PJI risk factors, and infection-free survivorship until final follow-up were retrieved. Multivariable analyses were conducted to determine the association between the antibiotic administered and development of PJI.

RESULTS: Among 7,713 SA, 6,879 (89.2%) received cefazolin and 834 (10.8%) received non-cefazolin antibiotics consisting of vancomycin (n = 465, 6.0%), clindamycin (n = 347, 4.5%), and alternative regimens (n = 24, 0.31%). PJIs occurred in 101 SA (1.3%) with *Cutibacterium acnes* as the most common pathogen (n = 44, 43.6%). Infection-free survivorship was higher among SA receiving cefazolin compared to non-cefazolin with 0.91% higher survival free of infection at one month, 1.41% at one year, and 2.67% at fifteen years (p < 0.001). Cefazolin administration was associated with a 68% and 80% reduction in all cause and *Cutibacterium acnes* PJI risk compared to non-cefazolin (p < 0.001). A higher risk of all cause and *Cutibacterium acnes* PJI was observed with vancomycin (hazard ratio [HR], 2.28 [95% confidence interval [CI], 1.20 to 4.33]; p = 0.012 and HR, 3.06 [95% CI, 1.18 to 7.92]; p = 0.021) and clindamycin (HR, 5.08 [95% CI, 2.83 to 9.09]; p < 0.001 and HR, 8.81 [95% CI, 3.97 to 19.53]; p < 0.001).

CONCLUSION: In primary SA, cefazolin administration was associated with a significantly lower rate of PJI compared to non-cefazolin alternatives including both vancomycin and clindamycin. These risk discrepancies were observed across all infectious pathogens and may be considered even greater when *Cutibacterium acnes* was the infecting bacterium.

LEVEL OF EVIDENCE: III, Retrospective cohort study

Paper 85

Does Concurrent Arthroscopic Rotator Interval Release Reduce Post-Operative Stiffness following Rotator Cuff Repair?

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BACKGROUND: Current standard of care for arthroscopic rotator cuff repair does not call for concurrent rotator interval release. However, no negative outcomes from performing interval release in conjunction with a patient's primary repair have been reported. Literature remains sparse in respect to postoperative outcomes and timing of the interval release. Therefore, the aim of our study was to compare outcomes of stiffness and pain between patients who underwent arthroscopic rotator cuff repair with rotator interval release against those who solely underwent rotator cuff repair.

METHODS: A single-blinded, randomized control trial (RCT) was conducted between September 2018 and April 2021. Patients were randomized into two groups: patients undergoing arthroscopic rotator cuff repair with interval release (treatment) and patients undergoing arthroscopic rotator cuff repair without interval release (control). Patients were also asked to maintain a postoperative log describing their daily pain and use of pain medications. American Shoulder and Elbow Surgeons Shoulder Score (ASES) and Visual Analog Scale (VAS) score as well as range of motion (ROM) were assessed at the following time points: 1 hour, 2 hours, 4 hours, 8 hours, 24 hours, 36 hours, 48 hours, 4-6 weeks, 3 months, and 6 months postoperatively.

RESULTS: 81 patients were prospectively enrolled in our RCT. Association between time point and VAS score, ASES, and average pain medication use did not depend on group assignment ($p = 0.31$, $p = 0.18$, and $p = 0.25$, respectively). Similarly, the association between time point and adducted external rotation (ER) and forward flexion (FF) improvement did not depend on group assignment ($p = 0.11$ and $p = 0.49$, respectively). Although clinically insignificant, those assigned to the treatment group experienced 1.39 and 8.72 degrees greater improvement in adducted ER and FF, respectively, as compared to the control group.

CONCLUSION: Our RCT compared currently accepted protocol that calls for arthroscopic rotator cuff repair without rotator interval release to arthroscopic rotator cuff repair with rotator interval release and found neither statistically or clinically significant differences in outcomes and postoperative ROM at any time point. We observed a quantitative improvement in ROM in patients who had concurrent interval release during their rotator cuff repair, albeit small with unlikely clinical relevance. Further research is warranted before recommendations may be made to propose a change in current standard of care for arthroscopic rotator cuff repair to include concurrent rotator interval release.

Paper 86

The Critical Shoulder Angle as a Highly Specific Predictor of a Full-Thickness Rotator Cuff Tear: A Case-Control Study

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HYPOTHESIS: The critical shoulder angle (CSA) has become an important topic of study in patients with rotator cuff tears. However, there is conflicting data on whether the CSA can differentiate between patients with normal shoulder pathology and full-thickness rotator cuff tears (RCTs) on true AP shoulder radiographs. The purpose of this study was to define the relationship between full-thickness RCTs and CSA. We hypothesize that patients with full-thickness RCTs have an increased CSA in comparison to matched controls.

METHODS: This retrospective case-control study identified patients with MRI proven full-thickness rotator cuff tears between December 2009 and December 2019. A 1:1 propensity score match was performed to identify a control group with normal rotator cuffs, while controlling for age, sex, body mass index (BMI), and tobacco use. A total cohort of N = 532 was identified, with N = 266 cases and N = 266 controls. Two independent observers measured CSAs for all patients on true AP shoulder radiographs.

RESULTS: There was no difference in baseline demographics (age, gender, BMI, tobacco use) between the RCT group and the non-RCT group ($p > 0.05$). The mean CSA for the entire cohort was 33.6 ± 4.2 . The mean CSA for the RCT case group, 36.2 ± 3.3 , was significantly different from the mean CSA for the control group, 30.9 ± 3.3 ($p < 0.0001$). ROC curve analysis produced an area under the curve of 0.88 ($p < 0.0001$). At CSAs greater than 35 degrees, there was a 67.7% sensitivity and 89.4% specificity for having a full thickness RCT. Lastly, each degree of increase in CSA increased the likelihood of having an associated rotator cuff tear by 1.7 times (OR 1.7 95% confidence interval: 1.551-1.852; $p < 0.0001$).

CONCLUSION: Patients with RCTs tend to have significantly higher CSAs compared to matched controls. This study shows that increased CSA is an independent risk factor for RCTs, with an odds ratio of 1.7 per degree. This study also shows that CSA is an accurate test (AUC 0.88) with good sensitivity (67.7%) and specificity (89.4%) at values greater than 35 degrees. CSA is a simple, highly reproducible measurement that can assist in clinical decision making regarding full thickness RCTs.

Paper 87

Biomechanics of a Rotator Cuff Deficient Shoulder and the Effects of Acellular Dermal Matrix Allograft Reconstruction Techniques

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INTRODUCTION: Acellular dermal allograft reconstruction techniques offer an alternative in the treatment of irreparable rotator cuff tears. Multiple reconstruction procedures exist now including Superior Capsular Reconstruction (SCR), Bursal Acromial Reconstruction (BAR), and a combined SCR-plus procedure. This study aimed to analyze each of these procedures in regard to functional abduction force, superior humeral head migration, and passive range of motion in a cadaveric model.

METHODS: Eight fresh-frozen cadaveric shoulders were tested in a custom biomechanical testing apparatus in 6 progressive conditions: (1) intact, (2) 50% tear in supraspinatus, (3) 100% tear in supraspinatus, (4) SCR, (5) SCR-plus, (6) BAR. Shoulder parameters were tested statically at 0°, 30°, 60°, and 90° of glenohumeral abduction in each condition. Data was analyzed with t-test.

RESULTS: Abduction force at 30° and 60° in the 100% tear condition were found to be significantly decreased compared to the intact condition ($p = 0.001$, $p = 0.002$, respectively), while no significant difference in abduction force was found between intact and 50% tear conditions. SCR was found to significantly improve abduction force compared to 100% rotator cuff tear at all abduction angles ($p < 0.05$) restoring force to a physiologic level. Abduction force at 0°, 30°, and 60° in SCR conditions was not found to be significantly different from that in SCR-plus ($p = 0.287$, $p = 1$, $p = 0.435$, respectively). All treatment interventions decreased superior humeral head migration compared to 100% tear with no significant difference found between the SCR, BAR, and SCR-plus conditions and the intact condition, respectively. Passive range of motion in abduction was found to increase with both 50% and 100% tears compared to the intact condition ($p = 0.01$ and $p = 0.02$, respectively), while SCR was seen to restore range of motion to levels not significantly different from that in the intact condition. Compared to the intact condition, SCR-plus led to a significant increase in forward flexion ($p = 0.03$), while BAR led to a significant increase in both forward flexion and extension ($p = 0.001$ and $p = 0.002$, respectively). SCR was also found to have decreased rotational range of motion at increasing abduction angles, a trend not observed in the SCR-plus and BAR conditions.

CONCLUSION: Dermal allograft reconstruction techniques offer benefits for restoring the glenohumeral force couple. All techniques restore the acromial humeral interval with potential improvement in pain, abduction force, and range of motion.

Paper 88

Courses of Iatrogenic Nerve Injuries Following Shoulder Surgery

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BACKGROUND: Nerve injuries are one of the most frequent complications after shoulder surgery. Although most demonstrate spontaneous resolution, some require surgical intervention to improve outcomes. We designed this study to 1) describe characteristics of patients sustaining nerve injury following shoulder surgery, 2) evaluate referral patterns to nerve surgeons, and 3) characterize nerve surgeries performed and their outcomes. Our aim is to better inform patients and providers of the potential course of such complications and the appropriate next steps.

METHODS: We performed a retrospective chart review of patients referred for postoperative shoulder surgery iatrogenic nerve injuries between 2007 and 2015. Final analysis included 65 patients. Demographics, operative data, and clinical diagnostic information of the nerve injuries were reviewed. Time to referral to nerve surgeon was analyzed. Proportional changes in the Disabilities of the Arm, Shoulder, and Hand (DASH) scores and MRC grades were calculated. If nerve surgery was performed, type of procedure and clinical outcomes were noted. Surgical outcomes were categorized as failed, partially successful, and successful based on final follow-up data.

RESULTS: Referrals included arthroscopic surgeries (35.4%), shoulder arthroplasties (24.6%), open shoulder procedures (21.5%), and combined open and arthroscopic procedures (18.5%). Initial traumatic injury was present in 49% of patients. Seventy-two percent received a preoperative block. Mean time to referral from nerve injury was 7.6 months, ranging from a mean of 148 days for open surgeries to a mean of 308 days for arthroscopic. Average follow-up was 13.3 months. Thirty-three injuries involved the brachial plexus, 23 injuries involved individual peripheral nerve branches, 7 injuries affected multiple terminal peripheral nerve branches, and 2 patients has complex regional pain syndrome. Thirty-five patients underwent surgical procedures while 25 (38%) of nerve injuries demonstrated spontaneous recovery without surgical intervention. Of the surgical interventions, 27 (77%) were successful, 3 (8.5%) were partially successful, and 3 (8.5%) failed. Out of 42 patients with motor deficits, 35 (76%) improved at least 1 MRC grade and 11 (24%) were unchanged at follow-up. Average DASH scores decreased 22% from initial clinic visit (n = 53) to final follow-up (n = 42).

DISCUSSION: This is the largest series of patients with iatrogenic nerve injury following a variety of shoulder surgeries to date. Our data demonstrates a consistent lack of timely referral to nerve surgeons, especially after arthroscopy. There continues to be a variable injury pattern even among similar surgeries. Despite this, timely surgical intervention, when indicated, leads to favorable outcomes.

Paper 89

Cost of Arthroscopic Rotator Cuff Repairs Is Primarily Driven by Procedure-Level Factors: A Single-Institution Analysis of an Ambulatory Surgery Center

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PURPOSE: To identify intraoperative drivers of cost associated with arthroscopic rotator cuff repairs (RCRs) through analysis of an institutional database.

METHODS: This was a single-institution retrospective review of arthroscopic RCRs performed at an ambulatory surgical center between November 2016 and July 2019. Patient-level factors analyzed included age, sex, insurance type (private, Medicare, Medicaid, self-pay, and other government), American Society of Anesthesiologists grade (I, II, III, and missing), and Charlson comorbidity index (0, 1, 2, and ≥ 3). Procedure-level factors included use of biologics (decellularized dermal allograft or bioinductive healing implant), anesthesia type (regional block, monitored anesthesia care, or general), number of anchors and sutures, additional procedures (biceps tenodesis, distal clavicle resection, subacromial decompression), and operative time. Multivariate linear regression analysis was used to identify factors significantly associated with higher or lower charges.

RESULTS: A total of 712 arthroscopic RCRs were included. The risk-adjusted operative charges were \$19,728 (95% confidence interval \$16,543 to \$22,913). The above factors predicted nearly 65% of the variability in operative charges. The only patient-level factor significantly associated with lower charges was female sex (- \$1,339; $P = .002$). Procedure-level factors significantly associated with higher charges were use of biologics (+ \$17,791; $P < .001$), concurrent open biceps tenodesis (+ \$4,027; $P < .001$), distal clavicle resection (+ \$2,266; $P = .039$), use of regional block (+ \$1,256; $P = .004$), number of anchors (+ \$2,245/anchor; $P < .001$), and increasing operative time (\$26/min). Other factors had no significant association.

CONCLUSION: Procedural factors are the most significant drivers of operative cost in arthroscopic RCRs, such as quantity and type of implants; additional procedures such as biceps tenodesis and distal clavicle resection; and perioperative conditions such as type of anesthesia and total operating room time. Overall, patient-level factors were not shown to correlate well with operative costs, other than lower charges with female sex.

LEVEL OF EVIDENCE: IV, economic study.

Paper 90

Glenoid Labrum Reconstruction with Superiorly Connected Long Head of the Biceps Tendon Autograft: A Cadaveric Biomechanical Study

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BACKGROUND: Rates of recurrent shoulder instability remain high, even following arthroscopic Bankart repair. It is known that the stability of the shoulder improves with increased concavity. However, restoration of the of the labrum's function to increase the depth of the glenoid becomes problematic in the scenario of attritional degradation, or other causes resulting in poor capsulo-labral tissue quality. In treating this pathology, we have devised a method to reconstruct the glenoid labrum utilizing the longhead of the biceps tendon (LHBT) as a local autograft. The goal of this study was to assess biomechanical constraint afforded by this construct in a cadaveric model.

METHODS: Cadaveric shoulders were inspected for inclusion based on cartilage quality and underlying LHBT pathology. After exclusion of 2 shoulders, 10 shoulders underwent resection of all soft tissue structures except the labrum and LHBT. LHBT length to the pectoralis major insertion and diameter were recorded. The scapula and humerus were separately attached to a custom shoulder testing apparatus allowing for 22.5N of compressive isotonic force across the joint. An instron (Electroplus 1000) measured the peak force (N) as the humeral head was translated over the anteroinferior glenoid rim through 10 cycles. Shoulders were tested in three separate scenarios: labral intact, labral resected from 3-6 o'clock (for a right shoulder), and labral reconstruction with the LHBT. Reconstruction was performed by performing LHBT tenotomy at the level of the pectoralis major insertion. The proximal LHBT tendon, left attached to the supraglenoid tubercle, was then attached to the anteroinferior glenoid rim with suture anchors.

RESULTS: Average length of the LHB was 76.1 mm (\pm 12.9 mm) and the diameter was 5.9 mm (\pm 1.6 mm). Peak force for labrum intact was significantly greater than labral deficient (14.06N vs. 11.78N; $p = 0.012$). Peak force for labral reconstruction (16.67N) was significantly greater than both labral intact and labral deficient states ($p < 0.001$ and $p = 0.011$, respectively). The length for the LHBT to the pectoralis major insertion was adequate, in all specimens, for reconstruction of the labrum.

CONCLUSION: Glenoid labrum reconstruction with the LHBT is a feasible option to restore glenohumeral stability, with peak force to displacement significantly greater than the labral intact and labral deficient states. We believe that this novel reconstruction may be an option for augmentation in the labral deficient shoulder with adequate bone stock.

Paper 91

Outcomes of Arthroscopic Stabilization for Anterior Shoulder Instability in Pediatric Patients

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BACKGROUND: Traumatic shoulder instability is a common condition with an incidence of 1.7% in the general population and high recurrence in adolescents managed conservatively. However, stabilization in adolescents has been shown to have high rates of recurrence approaching 25% in some studies. Literature is limited, though, as most studies investigate older adolescent patients aged 15-18 or within a group including adults. Recent literature has questioned whether patients less than 14 years of age incur the same recurrent instability risk. To our knowledge, no study has evaluated recurrence rates for children 14 years or younger following arthroscopic shoulder stabilization. Our study aims to better characterize recurrent instability following stabilization specifically in patients ≤ 14 years of age.

METHODS: This is a retrospective case series of patients 14 years of age or younger with anterior shoulder instability treated with arthroscopic stabilization and a minimum follow-up of 18 months. A telephone survey was conducted to identify rates of recurrent instability, revision surgery, and return to sport (RTS) status, as well as ROWE and SANE scores. The primary outcome was rate of recurrent instability. Secondary outcomes included rates of revision surgery and RTS, as well as ROWE and SANE scores.

RESULTS: Twenty-seven patients met inclusion criteria. Eleven (41%) telephone surveys were completed, with a mean age at surgery of 14.5 years. A majority of patients were contact athletes and male (72.7%). Eight (72.7%) had evidence of Hill-Sachs lesions and two (18.1%) had bony Bankart lesions preoperatively. Preoperatively, five (45.5%) of the patients had recurrent dislocations. All patients underwent anterior capsulolabral repair with two (18.2%) having a concomitant bony Bankart lesion incorporated into repair and one (9.1%) required loose body removal. Two (18.2%) had recurrent instability episodes postoperatively, and both underwent revision surgery. Ten (90.9%) were able to RTS at a competitive level at the same or better level of performance. Mean ROWE score was 95.45 (SD 7.9; range 80.0-100.0) and mean SANE score was 89.55 (SD 7.6; range 75.0-100.0).

CONCLUSION: The recurrence rate in our study is similar to rates previously reported in prior studies with older adolescent patients, 5-20%. This study demonstrates that arthroscopic stabilization in appropriately selected pediatric patients can achieve satisfactory outcomes with low recurrence rates and high RTS rates and functional outcome scores. Further studies are needed to better characterize the differences between adolescents pre- and post-skeletal maturity.

Paper 92

Anteroinferior Glenoid Rim Fractures in Shoulder Instability Patients Over 50: A Matched Cohort Analysis of Risk Factors, Treatment Strategies, and Outcomes

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BACKGROUND: Although they are common, there remains a paucity of data regarding traumatic anterior shoulder dislocations (ASI) associated with anteroinferior glenoid rim fractures (AGRF) in older patients.

PURPOSE: To describe the incidence of AGRF in this population following ASI, identify risk factors for AGRF, compare treatment strategies, and compare clinical outcomes of patients with and without an associated AGRF.

STUDY DESIGN: Matched cohort study

METHODS: An established geographic medical record system was used to identify patients >50 years of age with ASI between 1994 and 2016. Patients with radiographic evidence of AGRF were identified and matched 1:1 to patients without AGRF. Comparative analysis was conducted to determine differences between groups.

RESULTS: Overall, 186 patients were identified with a mean follow-up of 10.4 years (range, 2.0 – 25.4). Of these, 42 (22.6%) had AGRF and were matched to 42 control patients without AGRF. Average age was 58.9 and 58.2 years for the AGRF and control groups, respectively. Rates of surgical intervention (29% vs. 43%), recurrent instability (14% vs. 17%), progression of osteoarthritis (34% vs. 39%), and conversion to arthroplasty (2% vs. 5%) were similar between AGRF and control cohorts. Control patients were more likely to report recurrent pain ($p = .046$). For patients with AGRF, increased bone fragment size (OR 1.1) and increased BMI (OR 1.2) correlated with an increased risk for surgery. The cut-off value for surgery in patients with AGRF was a fragment size $\geq 33\%$ of the glenoid width.

CONCLUSION: In patients ≥ 50 years at presentation of ASI, 22.6% presented with an associated AGRF. Increased fragment size and greater patient BMI were significant factors associated with undergoing surgical intervention; however, most patients did not require surgery. Patients without AGRF were more likely to report recurrent pain, possibly due to a higher prevalence of rotator cuff derangement. Overall, the presence of an AGRF did not portend a worse prognosis as treatment strategies and long-term outcomes in terms of recurrent instability, progression of osteoarthritis, and conversion to arthroplasty were similar between patients with and without AGRF at the time of ASI diagnosis.

LEVEL OF EVIDENCE: IV

Paper 93

Long Term Outcomes of Distal Biceps Injuries: A Comparative Study of Surgical and Non-operative Management at a Mean Follow Up of 13 years

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BACKGROUND: Distal biceps tendon tears, although rare, significantly impair patient's elbow mobility and function. There is a paucity of contemporary literature reporting long-term outcomes of distal biceps (DB) injuries. Therefore, the authors sought to identify magnetic resonance imaging (MRI) confirmed distal bicep tears and report on (1) patient demographics and injury characteristics of all patients with distal bicep pathology, (2) outcomes of all patients with nonoperatively managed DB pathology, and (3) outcomes of all patients with operatively managed DB pathology.

METHODS: Patients with an MRI-confirmed distal biceps rupture from 1996 to 2016 were identified through an institutional image database. Patients from the initial search were then cross-referenced with the Rochester Epidemiology Project (REP). Patients were included if they had complete medical records and ≥ 5 years of clinical follow-up. Patients with inflammatory arthritis and enthesitis, polytrauma, or incidental findings without clinical assessment were excluded. Medical records were reviewed to confirm the diagnosis and obtain study details.

RESULTS: Overall, 158 patients (22F, 136M, mean age: 51.5) were identified and included. Baseline patient demographics including BMI, handedness, laborer occupation, and gender were gathered. Patients had a mean clinical follow-up of 13 years. Outcomes analyzed included gross complications, such as re-rupture and infection, and daily functional outcomes, such as strength and range of motion (ROM). Although there were no statistically significant differences in elbow ROM based on treatment modality, raw data demonstrated increased gains in extension ROM and forearm supination strength for operatively treated patients. There were 7 re-operations (4%), 5 re-ruptures (3%), and overall 35% of the operatively treated cohort experienced a complication.

CONCLUSIONS: Patients with distal bicep pathology tended to be a male laborer in their 50s without clinically significantly associated risk factors. Overall, patients regained full ROM, and 83% were able to return to work without modifications whether managed operatively or nonoperatively. At long-term follow-up patients treated operatively missed more time from work, had no statistically significant gains in elbow flexion or supination strength, and were subject to potential postoperative complications. These results are influenced by surgeon selection bias. As such, careful patient selection for surgical intervention for distal biceps pathology should be employed; surgeons should consider restricting surgical intervention to patients who have significant clinical symptoms or fail nonoperative management.

Paper 94

The Effect of Intraoperative Platelet-Rich Plasma on Rotator Cuff Repair Revisions, Complications, and Cost

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INTRODUCTION: Rotator cuff tears are a common diagnosis, especially in older populations, and can lead to shoulder pain, weakness, and dysfunction. Cuff tears can be treated with injection, such as corticosteroid or platelet-rich plasma (PRP) injections, to mitigate the pain or accelerate healing, but many may progress to require rotator cuff repair (RCR) surgery. In recent years, the use of PRP injection during RCR has increased in popularity. There remains, however, conflicting evidence about its effectiveness. The goal of this study was to assess the revision rates, complications, and costs associated with intraoperative platelet-rich plasma injections during RCR compared to conventional non-PRP procedures.

METHODS: Medicare patients within the PearlDiver database who underwent RCR were identified and stratified by the presence of intraoperative PRP into a PRP cohort and non-intraoperative PRP cohort. Patients lacking a laterality modifier for the RCR procedure or patients who were not active in the database for at least one year following primary RCR were excluded. Subsequently, the intraoperative PRP group was matched with a 1:5 ratio to the non-intraoperative PRP group, controlling for age, sex, year of operation, specific RCR CPT code, and Charlson comorbidity index (CCI). After comparing the two group's demographics and comorbidities to ensure equivalence, the revision (ipsilateral RCR) and re-operation (any ipsilateral shoulder surgery) rates were determined within six months and a year after their initial RCR. The 90-day complication rate, including nerve injury, hematoma, infection, wound disruption, transfusion, and capsulitis, were also queried for amongst the two groups, along with the total cost on the day of surgery.

RESULTS: There were 401 patients who received intraoperative PRP injection during their RCR. This was matched with 2,000 RCR patients who did not have intraoperative PRP. The intraoperative PRP group had a lower, but non-significant, 1-year revision rate compared to non-PRP group (1.5% vs. 2.3%, $p = 0.313$). Furthermore, no significant difference was demonstrated in any of the aforementioned complication categories. The average reimbursement of the intraoperative PRP group ($\$5,367.87 \pm 2,768.51$) was higher than the non-PRP group ($\$4,661.27 \pm 1,581.94$) ($p < 0.001$).

DISCUSSION: Intraoperative PRP injection during RCR led to a non-significant decrease in re-operation rate, without an increase in complications, at a statistically significant higher day of surgery cost. Additional clinical studies are needed to better characterize the role and use of PRP injection when combined with rotator cuff repair.

Paper 95

An Epidemic Amidst a Pandemic: Musculoskeletal Firearm Injuries during the COVID-19 Pandemic

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BACKGROUND: There are longstanding socioeconomically-based disparities in our country, in part evidenced by firearm injuries, which have been magnified by COVID-19. An increase in firearm injuries during the COVID-19 pandemic could disproportionately impact socioeconomically disadvantaged patients. This study defines the frequency of orthopedic trauma service (OTS) consults and subsequent follow-up rates for firearm injuries during the COVID-19 pandemic.

METHODS: A prospectively collected database of orthopedic surgery trauma consults at a Level I, urban trauma center in the Midwest was queried for firearm injuries from January 2017 through September 2020. Consults were reviewed for patient demographics, injury characteristics, and treatment outcomes. A change in the relative frequency of consults was determined by comparing the frequency of consults during the COVID-19 pandemic (March 2020 – September 2020) to historical controls (January 2017 – February 2020). The zip code of each patient's home address was recorded and correlated with area deprivation index (ADI). Follow-up rates were compared between injuries occurring before and during the pandemic.

RESULTS: Eight hundred ninety firearm injuries were identified during the period of interest. There was a 57% increase in the daily rate of firearm injury consults during the pandemic. Patients presenting with firearm injuries were commonly male ($n = 786$, 88.3%) and young (Mean = 30.6 years, Median = 28.0 years). Payor mix consisted of 16.7% private health insurance, 11.9% Medicaid health insurance, 2.1% Medicare health insurance, and 69.0% no insurance (i.e., "self-pay"). Patients presenting with musculoskeletal GSW injuries lived in neighborhoods of greater socioeconomic disadvantage and 411 (46.2%) patients lived in areas categorized as the most socially deprived decile of the United States. Follow-up rates before and during the pandemic were not significantly different ($p > 0.05$).

CONCLUSION: There was a significant increase in firearm injuries during the COVID pandemic in the region served by our Level 1 trauma center, primarily affecting socioeconomically disadvantaged patients. However, the COVID pandemic did not affect the follow-up attendance rate for patients with firearm injuries.

Paper 96

Mortality of Orthopaedic Trauma Patients During the COVID-19 Pandemic: A Comparison Study of COVID-19 Positive and Negative Patients at a Level-1 Trauma Hospital

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BACKGROUND: The purpose of this study was to compare the 30-day mortality of Coronavirus Disease 2019 (COVID-19) positive patients and COVID-19 negative patients surgically treated for orthopedic trauma at a level 1 trauma hospital during the Coronavirus pandemic. A secondary objective was to compare the postoperative hospital course and length-of-stay.

METHODS: This is a single center retrospective review of all patients who underwent a non-elective orthopedic surgical procedure through a level 1 trauma institution during the height of the COVID-19 pandemic. All patients during this period received preoperative nasopharyngeal swab to determine COVID infection status. Patients who tested positive within 5 days prior to surgery were considered "positive" while patients who tested negative prior to surgery were considered "negative". Preoperative variables including age, race, gender, ASA (American Society of Anesthesia) physical classification, and BMI (Body Mass index, kg/m²) were compared between the COVID-positive cohort and the COVID-negative cohort. Peri- and postoperative mortality within 30 days, length of stay, ICU days, and ventilator use were also compared between the two cohorts.

RESULTS: This study included 471 total patients: 13 were COVID-19 positive, and 458 were COVID-19 negative prior to surgery. The average age of all patients was 41 ± 20 with no significant difference in the COVID-19 positive and negative groups ($p = .19$). The mortality rate in the COVID positive group was 0% vs. 0.7% in the COVID-19 negative group, with no significant difference between groups ($p = .77$). The COVID positive group vs. negative group had no significant difference in length of stay (7.4 days vs. 4.4 days, respectively, $p = .12$) or ICU days (.8 days vs. 1.8 days, respectively, $p < .26$).

CONCLUSIONS: There was a very low mortality rate when evaluating COVID positive orthopedic trauma patients at a level one trauma center during the COVID-19 pandemic. There were no differences between COVID positive and COVID negative orthopedic trauma patients with respect to mortality, length of stay, and ICU days.

Paper 97

Does Local Administration of Antibiotic Powder Increase the Risk of Nonunion in Tibial Plateau and Tibial Pilon Fractures?

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High-energy tibial plateau and pilon fractures are associated with high rates of postoperative infection. Local antibiotic administration has become popular in orthopedic trauma surgery, with recent literature supporting its use to help reduce infection rates. There is a paucity of literature assessing the potential complications, specifically, the increased risk of nonunion. Basic science studies have demonstrated that high local antibiotic concentrations of vancomycin and tobramycin result in mesenchymal stem cell and osteoblast cell death. We sought to assess the risk of nonunion associated with the use of local antibiotic powder in operatively treated tibial plateau and pilon fractures.

A retrospective review of high-energy tibial plateau and pilon fractures at a single Level-1 trauma center was conducted from 2017-2020. Inclusion criteria were (1) age > 18 years, (2) open reduction with internal fixation of tibial plateau (41-C), and pilon (43-C) fractures. Exclusion criteria were patients with <12 months follow-up, indeterminate use or dose of topical antibiotics, Gustillo-Anderson 2B and 2C open injuries, and low energy injuries. Demographic, surgical, and postoperative data were recorded and compared between antibiotic and no-antibiotic groups with the primary outcome being union or nonunion. Logistic regression was used to assess the association between antibiotic administration and nonunion.

Of 406 operative fracture cases, 207 fractures (121 41-C, 101 43-C) were included. Injuries were observed to occur more frequently in males (62% vs. 38%). Most common types of fractures encountered were C3 type (70% C3, 19% C1, 11% C2). Patients had similar proportions of open fractures when antibiotics were used (20% vs. 18%). Patients who received antibiotics were more likely to be temporized with an external fixator (85.2% vs. 68.0%) and have delay to definitive surgery (13 vs. 9.5 days). Surgical site infections were more common in the no-antibiotic group (15% vs. 11%). Nonunion rates were observed to be 14.8% in those who received antibiotics vs. 9.3% in those who did not. In the final adjusted logistic regression model, the data trended toward increased nonunion (OR 2.05; 95% CI: 0.77, 5.85) when using topical antibiotics, although the model did not reach statistical significance.

The use of topical antibiotics should be used with caution when applying them to high-energy periarticular fractures. The benefits of decreasing surgical site infections may not outweigh the increased risk of nonunion. Additional larger-scale studies are needed to confirm whether the use of topical antibiotics increase the risk of nonunion when applied to high-energy periarticular fractures.

Paper 98

The IPA, a modified numerical system for pain assessment and intervention

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INTRODUCTION: The objective of this study is to 1) construct a pain scale which provides accurate communication between health care providers and patients to improve the accuracy of pain assessment and efficacy of pain management. (We named this the interventional Pain Assessment (IPA) tool), 2) to validate this new pain scale with the numeric rating scale 0-10 (NRS).

METHODS: The IPA uses only 3 categories 0 = "I have no pain", 1 = "My pain is tolerable (no intervention needed)", and 2 = "my pain is intolerable, (intervention needed)". We compared this to the NRS 0-10 pain scale which can be assessed as 0 having no pain and 10 the worst pain imaginable. This was an IRB approved study. After consenting to the study, 322 patients who were recovering from fracture treatment were asked to rate their pain according to the NRS and the IPA. The order in which they were asked was alternated with each successive patient. We compared ratings of the IPA (1) tolerable pain to mild - moderate pain reported in the NRS (1-6) and, (2) intolerable pain to severe pain in the NRS (> 7). We also asked patients which scale they preferred. Statistical analysis included Kendall rank correlation (Kendall's τ) and Spearman's Rho to determine correlation with the NRS.

RESULTS: The IPA exhibited a statistically significant association with the NRS ($\tau = 0.58$, $p < .0001$). There were 23.6% patients who provided discordant answers; 4.7% regarded their mild-to-moderate pain as intolerable (15/322), while 18.9% reported their severe pain as tolerable (61/322). Eighty-two percent of patients preferred the IPA scale.

CONCLUSION: The IPA is a valid pain scale and has exhibited strong correlation to the NRS 0-10, displays simple minimally clinical important difference (MCID) calculation, and provides meaningful information on the effect of pain control modulation.

Paper 99

Impact on Provider Prescribing Patterns After Implementation of Departmental Opioid Protocols

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INTRODUCTION: Opioids remain a significant cause of mortality despite increased awareness amongst providers and patients. The purpose of this study is to compare the amount of opioids prescribed for patients undergoing operative fixation of ankle fractures before and after implementation of standardized pain protocols within the Orthopedic Trauma department.

METHODS: Patients who underwent fixation of an ankle fracture between January 2016 and October 2020 were retrospectively identified and divided into groups based on the protocol in place at the time of surgery. Group 1 patients were not associated with a pain protocol, Group 2 included patients within the first protocol (6 week taper), and Group 3 consisted of patients within the second protocol (3 week taper based off OTA Pain Task Force Guidelines). Adults prescribed opioids postoperatively were included. Patients managed nonoperatively or with additional injuries requiring surgery were excluded. The primary outcome measured was the total morphine milligram equivalents (MME) prescribed postoperatively. Secondary outcome measures included visual analogue scale (VAS) scores at one and three months post-op, MME per prescription, number of refills, and prescription duration.

RESULTS: Two hundred eighty-five patients were included in the final analysis. Age, gender and race were similar among groups. Approximately 56% were female and one-third of patients had a prior history of opioid use. The total MME decreased significantly over time with the implementation of each protocol, averaging 1770.8, 844.3 and 369.8 MME for Group 1, 2, and 3, respectively ($p < 0.0001$). No significant difference was found when comparing VAS scores at 1 and 3 months postop ($p = 0.42$ and 0.11). There were also statistically significant decreases in the mean MME per prescription (450.2 vs. 265.7 vs. 145.5 MME, $p < 0.05$), number of pills prescribed (284 vs. 128.2 vs. 69.5 pills, $p < 0.05$), and prescription duration (96.7 vs. 47.9 vs. 20.7 days, $p < 0.05$) when comparing Group 1 to Group 3. While there was an overall trend towards fewer refills with the initiation of each protocol, this difference was not statistically significant.

CONCLUSION: The implementation of a standardized postoperative opioid protocol for patients with ankle fractures decreased the amount of prescribed opioids to only 20% of what was previously prescribed without significant changes in patients' perception of pain. This protocol also decreased the number of refills provided and duration of opioid use while providing safer pain management after fixation of ankle fractures.

Paper 100

Resident Involvement is Associated with Improved Short-Term Outcomes in Hip Fracture Surgery

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INTRODUCTION: Approximately one-third of orthopedic procedures in the U.S. are performed at teaching hospitals. Previous studies have demonstrated resident involvement in orthopedic surgeries is associated with increased operative time and cost with equivocal or worse outcomes. Hip fractures represent a common orthopedic injury that often requires operative fixation. Hip fractures also represent a substantial financial burden to the healthcare system, estimated to incur 72% of total fracture cost. In this study, we evaluate outcomes of hip-fracture surgery at a single institution before and after the introduction of an orthopedic residency program.

METHODS: A prospective database was created of consecutive hip fractures that were treated with surgical intervention from January 2015 to January 2018. These cases were performed at a single institution by five orthopedic surgeons. Patients were divided into two groups based on resident involvement. Outcomes including operative time (defined as wheels-in to wheels-out time), length-of-stay (LOS), readmission rate, direct and indirect costs, implant, and OR supply costs were compared. Additional data were collected regarding demographics, American Society of Anesthesiologists Physical Status Score (ASA Score) and type of procedure performed.

RESULTS: In a 36-month period, 662 hip-fracture surgeries were performed by one-of-five surgeons. Residents were involved in 303 (45.8%) cases. There were no significant differences between the two groups with regards to ASA Score or type of procedure performed. Operative time was significantly longer in the resident group, 91.2 vs. 78.9 minutes (p-value = 0.004). However, LOS was significantly shorter in the resident group, 5.2 vs. 5.6 days (p-value = 0.003). There was no difference in the readmission rate between the two groups. Lastly, there were significant reductions in direct costs (8% reduction; $p < 0.001$).

CONCLUSION: A critical aspect of surgical training is direct surgical experience. Historically, the tradeoff for this experience was a negative effect on surgical outcomes and costs. Our institution maintains a hip-fracture database, established prior to the introduction of an orthopedic program. This created a unique opportunity to study the effect of resident education on patient care. We find that the introduction of residents significantly decreased LOS and direct costs, with no change in readmission rate. Operative time increased by 12.3 minutes; however, with a mean-operative-time under 85 minutes, the clinical significance is debatable. Our findings demonstrate that compared to an attending alone, the combination of an attending and a resident resulted in an improvement rather than a compromise in patient care.

Paper 101

Intramedullary Nailing of Concurrent Ipsilateral Fractures of the Tibia and Femur: Primary Synchronous Nailing vs. Staged Osteosynthesis with Temporizing External Fixation

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OBJECTIVES: The optimal timing to definitive osteosynthesis in the polytraumatized patient remains an unanswered question. Early total care, damage control orthopedics, and early appropriate care have been described to manage the fractures in these patients, but there is a paucity of literature specific to ipsilateral tibial and femoral fractures. We sought the perioperative outcomes of primary simultaneous intramedullary nailing (IMN) vs. temporizing external fixation (EF) of both fractures.

METHODS: A chart review of all patients who sustained fractures of the ipsilateral femur and tibia that were definitively treated with intramedullary nails (IMN) from August 2010 to January 2020 was performed. Two cohorts were examined: patients who underwent initial EF and those that were treated with synchronous IMNs primarily.

RESULTS: IMNs and EF were the initial treatment in 23 and 18 patients, respectively. The mean injury severity score (ISS) was not significantly different, 22.3 in the EF group vs. 17.8 in the IMN group, ($p = 0.1850$). The EF group had a significantly higher median total transfused units of packed red blood cells (PRBC) (6.5 vs. 2.0, $p = 0.0013$), a shorter median initial operative time (160.5 minutes vs. 224 minutes, $p = 0.0296$), and a longer median total operative time (384.5 minutes vs. 224 minutes, $p < 0.0001$). Rates of death, pneumonia, deep vein thrombosis, pulmonary embolism, re-operation, length of stay, days intubated, acute respiratory distress syndrome, and organ failure were not significantly different between the groups.

CONCLUSION: Primary IMN is equally as safe as provisional EF in the adequately resuscitated patient with ipsilateral femoral and tibial fractures. This consolidates the fixation of both fractures into a single surgery without increasing perioperative complications.

Paper 102

Intravenous Cefotetan Monotherapeutic Prophylaxis Improves Antibiotic Stewardship and Reduces Return to OR in Grade III Open Fractures

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INTRODUCTION: Current literature reports up to a 10% probability of infectious sequelae for Grade IIIA fractures, but up to 50% for Grades IIIB and IIIC. Prophylactic antibiotic regimens traditionally consist of cefazolin plus an aminoglycoside, piperacillin-tazobactam monotherapy, or ceftriaxone plus/minus vancomycin. Cefotetan, a second-generation cephalosporin, offers a wide spectrum of activity against both aerobes and anaerobes as well as against Gram-positive and Gram-negative bacteria. There is a dearth of literature establishing the efficacy of cefotetan within orthopaedic surgery.

METHODS: IRB approval was obtained for this retrospective cohort study. Patients between September 2010 and December 2019 were included from a single Level 1 regional trauma center. The primary intervention studied was cefotetan monotherapeutic prophylaxis versus any other antibiotic regimen. Patients were excluded for in-hospital mortality or amputation of the affected limb. Outcomes recorded encompassed patient comorbidities, preoperative fracture characteristics, and in-hospital/operative metrics. Postoperative outcomes up to 1 year included rates of surgical site infection (SSI), deep infection, and non-union; return to the emergency department (ED) and operating room (OR) as well as readmission related to the index fracture; and prescribed outpatient antibiotics.

RESULTS: 1-year data for 138 Type III open fractures were included (42 were in the cefotetan cohort). Cohorts did not differ significantly at baseline for age, sex, BMI, tobacco use, or diabetes. The cefotetan cohort received fewer in-house dose/day antibiotics ($P < 0.001$), was less likely to receive outpatient antibiotics in the following year ($P = 0.023$), had decreased return to the OR (34.9% versus 55%, $P = 0.030$), and demonstrated non-union rates of 16.7% versus 28.1% ($P = 0.151$). When adjusted for length of stay (LOS), the dose/day total costs for antibiotics were \$8.71/day more expensive for the cefotetan cohort ($P = 0.002$). Type III open fractures incurred overall rates of SSI reaching 16.7% in the cefotetan cohort and 14.7% for non-cefotetan ($P = 0.773$). Deep infections necessitating return to the OR were 9.5% and 11.6%, respectively ($P = 0.719$).

DISCUSSION & CONCLUSION: The primary limitation of this study is related to its utilization of and reliance upon a retrospective convenience sample. Cefotetan alone may provide superior antibiotic stewardship with similar infectious sequelae and cost compared to other more traditional antibiotic prophylaxis regimens for Type III open long bone fractures.

Paper 103

Immediate Fixation of Acetabular Fractures via an Anterior Approach Does Not Increase Morbidity or Mortality

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PURPOSE: To determine if immediate fixation of acetabular fractures within 24 hours utilizing an anterior approach demonstrates significant difference in blood loss or intraoperative transfusions, postoperative length of stay, and complications or mortality compared to acetabular fractures treated after 24 hours.

METHODS: A retrospective review identified 238 acetabular fractures surgically treated via an anterior approach at a single Level 1 trauma center from January 2015 to June 2020. Ninety-three patients were cleared within 24 hours of injury and thus formed our study cohort. Surgical approaches included the ilioinguinal, modified Stoppa, iliofemoral, lateral window, or any combination. Bilateral injuries, posterior approaches, percutaneous fixation alone, and pediatric patients were excluded. Demographics, hours from injury to the OR, fracture classification, surgical approach, cell saver use, transfusions, complications, and mortality rates were recorded. Statistical analysis was performed using t-tests for continuous measures and Fischer's exact test and Chi-square tests for categorical variables.

RESULTS: Thirty-two patients underwent surgery within 24 hours of injury with a mean time to fixation of 17 hours (+/- 4.4 hours) compared to 44 hours (+/- 14 hours) in the delayed group. The immediate fixation group demonstrated a mean ISS of 11 (range 4-36) compared to 12 in the delayed group (range 4-66) ($P = 0.59$) and a mean Charlson Comorbidity Index at 1.5 compared to 3.8 ($P = 0.00$). ASA classes were evenly distributed. One-third of the immediate fixation group had complex both column acetabular injuries, and 25% had a concomitant pelvic ring injury. There were no statistically significant differences in fracture pattern classification, blood loss, cell saver use, or intraoperative transfusions.

Six patients in the delayed group (9.8%) returned to the OR for a complication compared to 1 patient (3.1%) in the immediate group ($P = 0.42$). Three patients in the delayed group (4.9%) developed a surgical site infection compared to none (0%) in the immediate group ($P = 0.55$). The immediate group stayed on average 7 days postoperatively compared to 11 days in the delayed fixation group ($P = 0.01$), suggesting a length of stay advantage with immediate surgery. There were no significant differences in 30 or 90-day mortality rates.

CONCLUSION: Medically cleared patients with acetabular fractures requiring an anterior approach may undergo immediate fixation within 24 hours of injury without increased blood loss, transfusions, or complications, including 30 or 90-day mortality. Further, prompt surgical management is associated with a shorter length of stay.

Paper 104

Rate of Secondary Surgery and Implant Removal Following Superior, Pre-Contoured Plating of Mid-Shaft Clavicle Fractures

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BACKGROUND: Open reduction and internal fixation (ORIF) of mid-shaft clavicle fractures is a reliable treatment modality, with excellent union rate and a low incidence of complications. However, debate exists as to the ideal plate position. Patient functional results appear to be equivalent, regardless of whether the plate is placed on the superior or anterior-inferior (AI) aspect of the clavicle. Therefore, the rate of implant removal may serve as a key differentiating factor between the two plate positions. We sought to evaluate the rate of secondary surgery and implant removal for superior plates at our institution, hypothesizing the rate would be similar to what has been reported in the literature for AI plates.

METHODS: We attempted to contact by telephone 146 consecutive patients who underwent ORIF of acute clavicle fractures or nonunions from 2014 to 2018 by one of two orthopedic trauma surgeons who use pre-contoured, 3.5 mm, superior plates. Ninety patients were ultimately included in the study. Primary outcomes were any secondary surgery on the clavicle and whether implants had been removed. Secondary outcomes included the American Society of Shoulder and Elbow Surgeons (ASES) shoulder score, the abbreviated Disability of Arm, Shoulder, and Hand (quick DASH) score, and a 3-item questionnaire asking patients about implant irritation.

RESULTS: Average follow-up was 4.1 years (minimum 2 years). Five of 90 patients (5.6%) underwent secondary surgery. Two of these surgeries occurred in the early postoperative period: one was a revision of the construct for hardware failure (those implants are still in place) and the other was a removal of hardware for infection. Three of 90 patients (3.3%) underwent implant removal because of perceived tenderness or irritation. The average quick DASH score of all patients was 6.27 and the average ASES score was 93.6. Of the 86 patients with implants still in place, no patients complained of severe irritation, 6 complained of moderate irritation, and 80 endorsed mild or no irritation.

CONCLUSION: With increasing utilization of plate and screw constructs in clavicle ORIF, the rate of implant irritation and need for subsequent implant removal may be key factors in swaying surgeons to choose superior or AI plate positions. While the literature would seem to favor the AI plate position, the current study shows that the superior plate position remains a viable option with potentially low rates of implant irritation and removal.

Paper 105

Acute Vs. Delayed Surgery for Midshaft Clavicle Fractures: A Systematic Review

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Displaced midshaft clavicle fracture treatment is a debated topic. Historically, these fractures were treated nonoperatively, but recent studies have shown lower risk of nonunion with surgical treatment. Despite several studies describing the treatment of midshaft clavicle fractures, a consensus on the best treatment method has not been reached. Additionally, one study shows routine surgical treatment of these fractures is not cost effective. Therefore, there is a need to analyze the functional outcomes and complication rates of acute vs. delayed surgery for midshaft clavicle fractures.

PubMed, CinAHL, Embase, Sport Discus, and Cochrane Central Register of Controlled Trials were searched for relevant studies up until January 2021. Two independent reviewers analyzed the resulting articles to locate studies that met the inclusion criteria. We reviewed the included papers for demographic factors including age, fracture type, time to surgery, and gender. Complications, nonunions, reoperations, and functional outcome scores from each study were pooled; the results are described here.

Seventeen randomized controlled trials and 2 prospective cohort studies describing acute fixation (operation <6 weeks from fracture) of midshaft clavicle fractures in 1,158 patients, and 1 prospective cohort and 1 randomized controlled trial describing delayed fixation in 44 patients. Reported mean DASH scores at 12 months or later ranged from 0.5 to 8.6 in patients receiving acute operation and from 8.7 to 17.6 in patients who underwent delayed operation. Constant & Murley scores beyond 12 months in the acute group ranged from 94-96 and was 86 in the delayed group. The patients in the acute group had 181 reoperations, and the delayed group had 15. In the acute group, there were 375 total complications compared to 28 in the delayed group. Union rate ranged from 94.74 to 100.0 in all acute surgery studies and from 72.73 to 100.0 in delayed surgery studies.

No studies with sufficient level-of-evidence directly compared acute vs. delayed fixation of midshaft clavicle fractures; therefore, a meta-analysis was not possible. Some studies have shown favorable results in delayed surgery or reoperation for nonunion of midshaft clavicle fractures. Yet, this review found functional outcomes, reoperation rates, union percentage, and complication rates to be superior in the acute fixation group. However, it is paramount that prospective studies comparing acute and delayed fixation of midshaft clavicle fractures be undertaken to further understand the best treatment protocol for these fractures.

Paper 106

Complications Associated with Administration of Post-Operative Weight Based Lovenox in Obese Orthopaedic Trauma Patients

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BACKGROUND: In orthopedic specific patients, limited evidence exists in regard to prophylactic weight-based enoxaparin (lovenox) dosing in the obese population. We examined clinical outcomes of administering weight-based Lovenox to obese orthopedic trauma patients.

METHODS: This was a retrospective study of 679 patients underwent orthopedic trauma surgery and were admitted from 1/2016 to 6/2020 at a single institution. Of those 679 patients, 156 patients met our inclusion criteria. Blood transfusion, documented hematoma, DVT, and return visits to the OR after the administration of weight-based Lovenox were the primary endpoints assessed. Age, BMI, weight, injury severity score (ISS), sex, postoperative time to first dose of Lovenox, total daily dose of Lovenox, OR blood loss, OR time, patient co-morbidities, and pre/postop hemoglobin were evaluated for a potential relationship with the primary endpoints.

RESULTS: 156 patients met our inclusion criteria with a total of 185 surgeries performed. 36 of the 185 (19%) surgeries required postop blood transfusion after weight-based Lovenox was given. Higher ISS score, lower preop hemoglobin and lower postop hemoglobin were significant predictors of blood transfusion. Only increased postoperative time to first dose of Lovenox was significantly associated with DVT formation. 13 of the 156 patients (8.3%) had a postoperative hematoma after administration of Lovenox and 4 of the 13 patients required return to the OR for bleeding complications. ISS was the only significant predictor of postoperative hematoma formation.

CONCLUSION: Patients with a higher injury severity score are at an increased risk of adverse bleeding and may benefit from lower doses of enoxaparin administered earlier postoperatively.

Paper 107

Risks for Chronic Opioid Usage in Orthopedic Polytrauma Patients

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INTRODUCTION: Chronic opioid usage after surgery is a major concern, and overuse can lead to addiction, misuse, overdose, and death. There is particular worry in polytrauma patients who have multiple surgeries and are often treated with high doses of opioids. We sought to determine factors involved in chronic opioid use in orthopedic polytrauma patients.

METHODS: A retrospective chart review of orthopedic polytrauma was performed at a level one trauma center from 7/1/2017 to 6/30/2020. Polytrauma was defined as at least 2 lower extremity fractures (pelvis, femur, and tibia). Demographics were determined including age, gender, fracture type, number of fractures and surgeries, discharging service (Orthopedics or Trauma), injury severity score (ISS), total hospital days, pre-admission opioids, inpatient MMEs per day, initial discharge MMEs, and 1-year post-discharge total MMEs. Long-term opioid usage was defined as either 1) receiving an opioid prescription at least 6 months from surgery or 2) filling greater than 7,300 MMEs in the year following surgery (average 20 MMEs per day). T-tests were used to analyze continuous variables, t-tests and Mann-Whitney U tests were used for count variables, and chi-square tests were used for categorical variables.

RESULTS: 164 patients were included (age 45.5 +/- 17.1 years, gender 41% female, BMI 28.0 +/- 7.8, and 53% were smokers). 67 patients (40.9%) filled an opioid prescription after 6 months post-discharge and 22 patients (13.4%) were prescribed greater than 7,300 MMEs in the year following discharge. When defining chronic use as filling an opioid prescription after 6-months post-discharge, chronic users had more surgeries, pre-admission opioid prescriptions, inpatient MMEs per day, initial discharge MMEs, and 1-year post-discharge MMEs (all $p < .02$). When chronic use was defined as filling at least 7,300 MMEs in a year, factors associated with chronic use included the total number of fractures, pre-admission opioid use, inpatient MMEs per day, and initial discharge MMEs (all $p < .05$). There was no difference in chronic opioid use between different discharge services.

CONCLUSION: Chronic opioid use is common (40.9%) after polytrauma. Pre-admission opioid usage is an overwhelming predictor of continued usage. Inpatient opioids and quantity of opioids written at discharge are associated with long-term usage. These results emphasize the importance of minimizing opioid usage and maximizing non-narcotic modalities to avoid long-term problems. Pre-trauma chronic opioid use is common and a difficult condition to treat. Future work is needed in this group of patients to maximize outcomes.

Breakout Session #9 (Opioid Management)
Friday, April 08, 2022

Paper 108

Novel Approach For Opioid Prescribing Recommendation in an Orthopedic ASC

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BACKGROUND: The over prescription of opioids following orthopedic procedures is well documented, yet surgeons lack consensus on how to appropriately prescribe opioids to provide adequate postoperative pain relief. The goal of this study was to analyze the effectiveness of a novel method for determining prescribing guidelines for a group of orthopedic surgeons.

METHODS: An internal audit performed in 2018 at an orthopedic outpatient surgery center examined 13 orthopedic surgeons for two weeks and their prescriptions given for five common orthopedic procedures. After converting the prescriptions into Hydrocodone 5/325 equivalents, the mode prescription for each surgeon by procedure was calculated and shared with all the providers in the practice. The providers were given articles about physician influence in the opioid epidemic and were recommended to decrease their opioid prescriptions to match the surgeon with the lowest prescription for each procedure (Minimum Mode). Prescribing habits were re-assessed at one month and one year.

RESULTS: Over the course of this study, the maximum prescription for all five procedures decreased. The aggregate decrease in prescribing compared to the recommended amount decreased significantly from the initial prescribing to those at one month and significantly further decreased at one year. The most significant decrease was for Hip Arthroscopy, which decreased by 60%. 8/13 surgeons showed significant decreases in the number of opioids prescribed after 1 year.

CONCLUSION: This novel study suggests that an effective means to decrease overprescribing while still maintaining adequate pain control is by recommending postoperative prescribing guidelines based on the minimum mode of opiate prescription for a group of surgeons for each procedure.

Paper 109

A Reduction In Opioids Prescribed After Total Joint Arthroplasty As A Result of Statewide Registry Prescribing Protocol

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BACKGROUND: Excessive opioid prescriptions after total joint arthroplasty (TJA) elevates patient risk for adverse opioid related events and chronic opioid use, while increasing the availability of opioids for unlawful diversion. The safe reduction in the quantity of opioids prescribed postoperatively holds potential for quality improvement within the realm of joint replacement surgery. Concerns exist that a decrease in opioids prescribed postoperatively may correlate with an increase in complications such as readmissions, emergency department (ED) visits, or worsened patient reported outcomes (PROs). The purpose of this retrospective registry study was to explore whether a reduction in opioids prescribed after total joint arthroplasty resulted in an increased complication rate in a statewide registry.

METHODS: Data for this study was pulled from a statewide arthroplasty database. Demographic and clinical data was collected and entered for each case including OME prescribed at discharge, readmissions, ED visits within 30 days, and PROs. Trends were monitored using Shewhart control charts with upper and lower control limits for each outcome measure.

RESULTS: Overall, 85,614 total joint arthroplasties over a two-year period were included. All groups showed a reduction in opioids prescribed over the course of the study. Importantly, there was no increase in complications that occurred alongside this reduction. There were no significant increases in ED visits, readmissions, or KOOS/HOOS scores over the length of this study in any of the groups.

CONCLUSIONS: By publishing postoperative opioid prescription recommendations and subsequently adding it as a performance measure in a large joints registry there was a decrease in total oral morphine equivalents prescribed by almost half without worsened PROs or a corresponding rise in ED visits or hospital readmissions. Therefore, we conclude that a reduction in opioids prescribed after TJA can be performed safely without a rise in complications.

Paper 110

Variation in Opioid Prescribing in Post Total Joint Arthroplasty

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INTRODUCTION: There is a lack of consensus in the setting of postoperative pain control, with a severe deficiency in procedure-specific and patient-specific recommendations. This has led to a wide array of prescribing habits among surgeons for postoperative pain control, particularly among orthopedic surgeons. The aim of this retrospective analysis is to determine the variation in opioid refill requests after primary total hip and total knee arthroplasty at a single institution.

METHODS: Using CPT codes for primary hip and primary knee arthroplasty, a search was performed at one institution for all surgeons that performed total hip and knee arthroplasty over a 6- year period. Information that was retrieved included each time a an opioid medication was filled for each patient, the date and number of days after surgery at time of filling, the name and amount of each medication, a description of the prescribing provider, patient disposition information, and demographic information. Refills were converted to Milligram Morphine Equivalents (MME).

RESULTS: This is an ongoing study. From preliminary results there were a total of 5,645 prescriptions filled among 1,808 unique patients. 40.5% of these prescriptions were filled by males, 59.5% filled by females. The average age of the patients was 57.3 years old. There were approximately 3.1 refills per patient. 33.2% of prescriptions were written by resident physicians, 20.5% written by orthopedic attendings, and the remaining written by advanced practitioners and attendings of other specialties. 25.9% of the prescriptions were in varying forms of hydrocodone, 53.9% in varying forms of oxycodone, and 17.3% in varying forms of tramadol.

CONCLUSION: Based on our preliminary results, there is a wide spectrum of prescribing habits among surgeons and providers despite treating for the same procedure. The data suggests there is a need for a standardized protocol for treating pain specific to post total joint arthroplasty.

Paper 111

The Drivers of Persistent Opioid Use and Its Impact on Healthcare Utilization after Elective Spine Surgery

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INTRODUCTION: There is a high rate of persistent opioid use following spine surgery. The aim of this study is to determine the incidence of and risk factors for persistent opioid use after elective spine procedures at a single academic center and to quantify healthcare utilization within this subpopulation.

METHODS: Patients were retrospectively identified who underwent elective spine surgery for either cervical or lumbar degenerative pathology between November 1, 2013, and September 30, 2018, at a single, tertiary academic center. Patients were split into two cohorts, those with and without opioid use at 180 days postoperatively. Baseline patient demographics and underlying comorbidities, surgical variables, and preoperative opioid use were compared between these two groups. Univariate and multivariate logistic regression was used to identify potential risk factors for persistent opioid use after surgery. Additionally, the utilization of various healthcare resources within one year after surgery were compared between these two groups.

RESULTS: 583 patients were included. Patients with opioid persistence (16.7%) were more likely to have an American Society of Anesthesiologists (ASA) classification score of 3 or greater ($p = 0.004$), diabetes ($p = 0.019$), class I obesity ($p = 0.012$), an opioid prescription in the 60 days prior to surgery ($p = 0.006$), and less likely to have a Charlson comorbidity index (CCI) of 0 ($p = 0.031$). Regarding surgical factors, patients with opioid persistence were more likely to have foraminal ($p = 0.014$) or central ($p = 0.010$) stenosis and to have undergone multi-level lumbar ($p = 0.022$) or multi-level cervical arthrodesis ($p = 0.003$). Patients with opioid persistence were less likely to have undergone lumbar decompression alone (e.g., without arthrodesis) ($p = 0.027$). Univariate regression suggested the following predictors for opioid persistence: ASA class 3+, diabetes, an opioid prescription within 60-days prior to surgery, foraminal stenosis, central stenosis, and multi-level lumbar or cervical arthrodesis. Additionally, a CCI of 0 and simple lumbar decompression were associated with a decreased risk of opioid persistence. Persistent opioid use was associated with increased utilization of healthcare resources in the postoperative period including imaging studies, emergency department visits, and epidural or other spinal injections.

CONCLUSION: Opioid persistence following spine surgery is associated with various identifiable patient specific and surgical risk factors, and patterns of high health resource utilization.

Paper 112

Opioid Prescribing Habits After Single Level Posterior LuM.B.A.r Spine Surgery

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INTRODUCTION: Postoperative pain control is important, but there is variation in prescribing patterns and overprescribing commonly occurs. The purpose of this study is to determine the quantity of opioid pain pills being prescribed, risk factors for increased use, and the optimal amount needed to treat postoperative pain after single level posterior lumbar spine surgery, to improve prescribing practices.

METHODS: Opioid prescribing data from 180 patients (107 decompressions, 73 fusions) undergoing single level posterior lumbar spine decompression or instrumented fusion between 2018 to 2019 were retrospectively reviewed. Patients were excluded for age ≤ 18 years old, and surgery for trauma, tumor, infection, or revision. The quantity of 5-mg oxycodone equivalent pills prescribed upon discharge and total postoperatively including refills was recorded. Demographic data was documented including age, sex, BMI, ASA score, LOS, and pain scores. Analysis of prescribing patterns, utilization, and demographic data was performed.

RESULTS: The median number of 5-mg oxycodone equivalent opioid pills prescribed upon discharge was 30 pills (range, 0 to 120 pills) for decompression and 50 pills (range, 0 to 293 pills) fusion. The mean number of total pills prescribed including refills was 45.7 ± 29.5 for decompression and 77.5 ± 69.8 for fusion. There was a significant difference in refill utilization between groups with 13.0% of patients in the decompression group and 27.3% of patients in the fusion group requiring at least one refill ($p = 0.024$). The quantity of opioid pills prescribed upon discharge ($p = 0.0019$) and total ($p = 0.0004$) was significantly different between groups. Patients that were on opioids prior to surgery were prescribed significantly more pills upon discharge ($p = 0.0042$), total ($p = 0.0051$), and had higher refill utilization ($p = 0.030$). There is a positive correlation between pain score before surgery and total opioid pills prescribed ($R = 0.37$, $p = 0.0015$). No correlation exists between age, ASA score, or LOS and opioid use. There is a strong positive correlation between the number of pills prescribed upon discharge and total pills prescribed postoperatively (decompression, $R = 0.92$, $p < 0.001$; fusion, $R = 0.84$, $p < 0.001$).

CONCLUSION: Patients undergoing decompression require fewer opioid pills and refills than patients undergoing fusion. Preoperative opioid use and higher pain scores are predictors of increased postoperative opioid use and refill requirement. The number of pills prescribed upon discharge can be lowered to decrease total opioid use. We suggest an initial prescription of no more than 30 pills for single level decompression and 50 pills for fusion.

Paper 113

What Dose of Preoperative Opioids Affects Outcomes after Revision Total Knee Arthroplasty?

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INTRODUCTION: The purpose of this study was to identify the preoperative daily opioid dose associated with increased complications after revision total knee arthroplasty (TKA).

METHODS: Patients in the Humana claims database undergoing revision TKA (2007-2017) with an opioid prescription within three months prior to surgery were stratified based on daily opioid dose: Tier 1) <10 milligram morphine equivalents (MME), Tier 2) 10-25 MME, Tier 3) >25 MME. Each tier was matched 1:1 to opioid naïve patients. Emergency department (ED) visits and readmissions were compared at 90 days. Surgical complications were compared at two years. Relative risks (RR) were calculated.

RESULTS: Of 10,760 patients who underwent revision TKA, 4,968 (46.2%) were using preoperative opioids in the three months prior to surgery. After matching, length of stay was significantly longer in opioid users in all tiers (Tier 1: 6.26 vs. 5.61, $p = .003$; Tier 2: 6.79 vs. 5.76, $p = .002$; Tier 3: 7.24 vs. 6.05, $p < .001$). ED visits were significantly higher in patients taking preoperative opioids in all tiers (RR 1.15, 1.38, 1.43, respectively). Readmission was significantly higher in opioid users in Tier 3 (10.4% vs. 7.6%, $p = .008$). Risk of arthrodesis was significantly higher in Tiers 2 and 3 (RR: 2.38, 2.27 respectively). Subsequent revision surgery was significantly higher in opioid users in all tiers (RR 1.14, 1.19, 1.40 respectively).

CONCLUSIONS: Preoperative opioid use is associated with a dose-dependent increase in complications after revision TKA. Just two 5mg hydrocodone tablets daily leads to a significant increase in length of stay, ED visits, and revision surgery. Higher doses are associated with readmission, superficial infection, and arthrodesis. This study highlights the high prevalence of preoperative opioid use and the powerful effect that opioids have on postoperative outcomes after revision TKA.

Paper 114

Patterns of Opiate Prescription Practices in Isolated Operative Ankle Fractures: Creating Guidelines

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BACKGROUND: Opioid use is associated with significant morbidity and safer alternatives to pain control exist. The purpose of this study was to quantify our opioid prescribing practices for isolated, operative ankle fractures and to formulate guidelines for safe and effective opioid stewardship.

METHODS: The baseline average quantity of opioids prescribed (as Morphine Milligram Equivalents) at discharge and in the 90 days after surgery for adults with operatively treated, isolated ankle fractures was determined and prescribing guidelines were implemented. Opioid use was correlated to patient demographics, comorbidities, fracture characteristics, and patient reported pain control in each group.

RESULTS: The baseline and test groups had 37 (24 female, 13 male) and 34 (21 female, 13 male) patients, respectively. There was no significant difference in age (49.7 vs. 47.2 years), comorbidities, or open fractures (1 vs. 3). The mean MME prescribed was 444.86 (stdev = 314.9, range = 0 – 1425), vs. 361.5 (stdev 232.9, range = 112.5 – 1025). This 18.8% reduction was not statistically significant ($p = 0.32$). There was no difference in pain scores at the first or second postoperative visits (2.64 vs. 2.84 and 1.56 vs. 1.81). There was no correlation between patient demographics, comorbidities, or fracture characteristics and MME prescribed or pain scores. Patients with higher pain scores at the first visit had more MME prescribed ($p = 0.02$ and 0.03).

CONCLUSION: Postoperative opioid use in isolated, operative ankle fractures in adult patients was reduced without a significant difference in patient reported pain control, but the reduction was not statistically significant.

Paper 115

Chronic Opioid Use After Hip Fracture Repair

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INTRODUCTION: While interest has focused on opioid use after hip replacement, little research has investigated opioid use in elderly patients after hip fracture. We hypothesize that a substantial number of opioid-naïve elderly patients will go on to chronic opioid use after surgery for a hip fracture.

METHODS: 219 patients, ages 65 years and older, that underwent surgical fixation between 1/1/16 and 2/28/19 for a native hip fracture were reviewed (mean age 81 years old; 150 female, 69 male; mean BMI 24.5). Patients were excluded for polytrauma, periprosthetic fractures, pathologic fractures, or if they died or had other major surgery within 90 days of their hip surgery. The state prescription monitoring database was used to determine opioid use. Patients were considered opioid naïve if they did not fill a prescription in the three months before surgery. Chronic opioid use was defined as filling a prescription 6 months after surgery.

RESULTS: Overall, 58 patients (26%) were chronic opioid users. Of the 188 opioid naïve patients, 43 (23%) became chronic users. Of the 31 non-opioid naïve patients, 15 (48%) were chronic users. Chronic users were more likely to be male (34 of 58, 59% vs. 43 of 158, 27%, $p = 0.05$), had a lower age (78 vs. 82 years old, $p = 0.003$), and were more likely to be white (53 of 58, 91% vs. 125 of 158, 76%, $p = 0.04$). Fracture type, surgery type, and discharge destination did not affect the rate of chronic use. Arthroplasty (hemi, total) vs. non-arthroplasty (cannulated screws, dynamic hip screw, intermedullary nail) surgical options did not affect rate of chronic use.

CONCLUSION: A significant portion of elderly patients with a hip fracture will become chronic opioid users after hip fracture repair. 23% of patients who were opioid naïve before surgery became chronic users. Being younger, white, and male were risk factors for chronic usage. Chronic opioid usage after hip fracture repair is an issue even in opioid naïve patients. More attention should be paid to avoid chronic opioid usage in hip fracture patients.

Paper 116

Does Preoperative Opioid Consumption Predict Postoperative Opioid Dependence following ORIF of Olecranon Fractures?

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INTRODUCTION: Due to extremely painful orthopedic trauma and related procedure, orthopedic surgeons have often been the highest prescribers of opioid-based medications. Yet given the increased awareness of the opioid epidemic, orthopedic surgeons also have been tasked to help curtail the opioid epidemic in this country. Currently there are no particular tools to gauge appropriate consumption of opioids after orthopedic trauma such as olecranon fractures. The purpose of this study was to examine how preoperative opioid use and dependence would influence postoperative opioid dependence in patients undergoing open reduction and internal fixation (ORIF) for olecranon fractures.

METHODS: A retrospective review of all patients who underwent ORIF for olecranon fracture was performed within a single hospital system from 2018- 2020. Recorded variables included age, gender, BMI, and pre- and postoperative opioid prescriptions. Pre- and postoperative opioid dependence was defined as prescription opioid use as 3 months or greater, leading up to or following surgery, respectively. Pre- and postoperative opioid use was defined at 1 month or less, preceding or following the procedure. Odds ratio calculations were performed for each variable and a multivariate logistic regression was used to compare pre- and postoperative use and dependence.

RESULTS: This was a retrospective review of 29 patients surgically treated with ORIF. In the cohort, there were 18 women and 11 men with average age and BMI of 62.8 years and 27.4 kg/m², respectively. Nine cases were determined to be preoperatively opioid dependent while 20 cases were preoperatively opioid naïve. Average amount of opioids used was 110.6 TMEs for the overall cohort and 184.2 TMEs for the opioid dependent group postoperatively. Preoperative opioid dependence was found to have a 4.5 times increased risk for postoperative opioid dependence. However, preoperative opioid use and all other demographics were not found to have any significant influence on postoperative opioid dependence.

CONCLUSIONS: Our results demonstrate that postoperative opioid dependence following olecranon fractures can be correlated with preoperative opioid dependence. It is important for orthopedic surgeons to do detailed risks assessments preoperatively to identify at risk patients for postoperative opioid abuse and dependence. Patients who are preoperatively opioid dependent need more intensive patient education on their increased risk of opioid needs and dependence and additional help and guided opioid reduction programs following surgery.

Paper 117

Opioid-Limiting Legislation in Ohio Reduces Opioid Prescription Following Shoulder Arthroscopy

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INTRODUCTION: The use of opioids, both medically and recreationally, has fueled a public health emergency in the United States. State and federal governments have fought to curb the opioid epidemic as twenty-eight states have passed laws that limit opioid prescriptions, including the state of Ohio. The purpose of this study was to determine the effect of the Ohio's opioid prescription-limiting legislation on prescription patterns following shoulder arthroscopy.

METHODS: A retrospective review of patients undergoing shoulder arthroscopy between January 1, 2016, and March 31, 2020, by a single surgeon was performed. The pre-legislation and post-legislation cohorts were defined as patients undergoing surgery before or on/after August 31, 2017, respectively. Data regarding the number of opioid prescriptions and the morphine milligram equivalents (MME) per opioid prescription from 30-days preoperatively to 90-days postoperatively were extracted from the Ohio Automated Rx Reporting System, an online prescription drug monitoring database. Patients were classified as either opioid-tolerant or opioid-naïve if they had at least one or zero opioid prescriptions filled within 30 days of surgery, respectively. The statistical analyses were performed using software Stata 15.0 and R 3.4.1. Statistical significance was defined as $p < 0.05$.

RESULTS: A total of 279 (97 pre-legislation, 182 post-legislation; 42 opioid-tolerant, 237 opioid-naïve) patients were included for final analysis. There was a significant reduction in the cumulative MME prescribed in the immediate postoperative period (pre-legislation, 450 MME; post-legislation, 315 MME; $p < 0.001$), first 30 days postoperatively (pre-legislation, 590 MME; post-legislation, 375 MME; $p < 0.001$), and the first 90 days postoperatively (pre-legislation, 600 MME; post-legislation 420 MME; $p < 0.001$). The opioid-tolerant cohort had higher MME at every time point in the postoperative period ($p < 0.001$).

CONCLUSION: Opioid-limiting legislation passed in Ohio resulted in significant reductions in the cumulative MME prescribed after arthroscopic shoulder surgery in the first 30 postoperative days for both opioid-naïve and opioid-tolerant patients.

Paper 118

Effects of Opioid-Limiting Legislation on Postoperative Opioid Use in Shoulder Arthroplasty in the Epidemic Epicenter

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BACKGROUND: The current opioid epidemic in the US has become a public health crisis with an estimated 150 daily deaths and nearly 47,000 opioid related mortalities in the US in 2017 alone. Sensible prescriber practice changes have been a focus of policymakers to decrease the number of opioids in circulation. In Ohio, opioid prescription limits for acute pain were enacted in August 2017. Given the association of acute opioid exposure with long-term use and lack of assessment of these policies, there is an unmet need to evaluate the effects of similar legislation in Ohio on postoperative opioid dosing after shoulder arthroplasty. This study evaluates the effects of opioid prescription limiting legislation in Ohio on postoperative opioid dosing in shoulder arthroplasty and assesses risk factors related to long-term opioid use.

METHODS: All patients undergoing primary and revision shoulder arthroplasty over a 5-year period by a single surgeon were included. The pre- (PRE) and post-legislation (POST) groups were defined as patients undergoing shoulder arthroplasty before and on/after August 31, 2017, respectively. The Ohio Automated Rx Reporting System was queried for controlled substances from 30-days preoperatively to the 90-day postoperative period. Patients were designated as opioid-tolerant if they had filled an opioid prescription within 30 days of surgery. A binary logistic regression analysis was applied to assess factors related to long-term opioid use.

RESULTS: A total of 334 patients were categorized into 2 cohorts (PRE = 99, POST = 235). Accounting for legislative effects, there were significant reductions in cumulative morphine milligram equivalent (MME) dosing in the opioid-naïve at 7-day and 30-day postoperative periods (PRE = 450.0, POST = 210.0; $p < 0.001$) and the opioid-tolerant at 7-day postoperative period (PRE = 450.0, POST = 250.0; $p = 0.001$). Amongst the opioid-naïve patients, the POST group had significant MME reduction at the 90-day postoperative period relative to PRE cohort ($p < 0.001$). Preoperative opioid and benzodiazepine tolerances were independent risk factors for increased MME dosing at 90 days postoperatively (opioid-tolerance $p < 0.001$; benzodiazepine-tolerance $p = 0.02$).

CONCLUSION: Opioid prescription limiting legislation for acute pain in the state of Ohio is associated with a notable reduction in opioid MME dosing in the 90-day postoperative period after shoulder arthroplasty, particularly in opioid-naïve patients in the first 30 days postoperatively. Preoperative opioid tolerance leads to significantly higher MME dosing postoperatively after shoulder arthroplasty.

Paper 119

Risk Factors for Postoperative Opioid use after Medial Patellofemoral Ligament Reconstruction

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PURPOSE: The purpose of this study was to investigate which factors predispose patients for prolonged opioid use after medial patellofemoral ligament (MPFL) reconstruction.

METHODS: A retrospective review of all patients who underwent MPFL reconstruction at a single institution between January 2013 and June 2020 was conducted. Opioid consumption before and after surgery was recorded and confirmed using Michigan Automated Prescriptions System (MAPS) monitoring program. Patients were classified into preoperative opioid users and nonusers. Risk factors for continued opioid use were assessed by collecting patient demographic variables, psychiatric history, number of prior dislocations, and operative factors.

RESULTS: A total of 102 patients were included during the timeframe of interest. Patients were on average 21.6 ± 8.5 years old and had a mean BMI of 28.2 ± 7.9 . Thirty patients (29.0%) sustained >10 dislocations preoperatively. Preoperative opioid use was present in 13 (12.7%) patients. Greater than 10 dislocations (OR 5.00, 95% CI 1.12-20.92) and psychiatric history (OR 3.33, 95% CI, 1.2–9.1; $p = 0.016$) significantly predicted opioid refills in the first month after surgery. Risk factors for opioid refills at 2-12 months postoperatively included smoking (OR 4.50, 95% CI 1.13-17.96), preoperative opioid use (OR 7.32, 95% CI 1.88-28.47), psychiatric disorder (OR 3.77, 95% CI 2.3-6.2; $p < 0.001$), age >30 years (OR 7.03, 95% CI 3.63-13.61; $p < 0.001$), and obesity (OR 2.68, 95% CI 1.40-5.14; $p = 0.002$). Compared to Outerbridge 0, a higher percentage of patients with Outerbridge 1 or 2 and 3 or 4 continued using opioids 2-12 months after surgery ($p = 0.006$ and 0.01, respectively).

CONCLUSION: For patients undergoing MPFL reconstruction, preoperative opioid use, knee osteoarthritis, age >30 years, BMI >30, and history of psychiatric disorder were found to be significantly associated with prolonged opioid use after surgery. Postoperative opioid refills in this cohort, however, were relatively low and declined after one month.

Paper 120

Does the Type of Lower Extremity Fracture Affect Long-Term Opioid Usage? A Meta-Analysis

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BACKGROUND: Opioid medications are typically prescribed for pain management after orthopedic fractures. Use of opioids puts patients recovering from musculoskeletal trauma at particular risk for opioid dependence and misuse. We performed a meta-analysis of existing literature on opioid use following lower extremity trauma to examine the association between fracture type and the risk of developing chronic opioid use following fracture fixation.

METHODS: A meta-analysis was performed using two online databases (PubMed, Web of Science) to identify articles reporting chronic opioid use in patients having surgery for lower extremity fractures. A total of 732 articles were identified using keyword and MeSH search terminology. Nine studies met selection criteria, and several of these had separate samples for different fracture types. The primary outcome was the number of patients who remained on opioid medications six months after surgery (chronic usage). Logistic regression analysis was performed to determine the rate of chronic opioid use within each fracture type. Descriptive analyses were also performed to determine if age, year, country of origin, or pre-admission opioid use influenced chronic opioid use following surgery.

RESULTS: Bicondylar and unicondylar tibial plateau fractures had the largest percentage of patients that become chronic opioid users, 35.2% and 29.7% respectively, followed by hip (27.8%), unspecified ankle (19.7%), femoral shaft (18.5%), pilon (17.2%), and tibial shaft fractures (13.8%). Simple ankle fracture types had lower chronic opioid-use rates (2.8-4.7%). A total of 8 samples were opioid naïve, and 9 samples allowed pre-admission opioid use. All but 2 samples that excluded patients with pre-admission opioid use had significantly lower rates of chronic opioid use after surgery (2-9%, 95% CI) when compared to all but 1 of the samples that allowed pre-admission opioid use (13-50%, 95% CI). There were no significant associations between postoperative chronic opioid use and age, year, or country of origin of the study.

CONCLUSION: Patients who undergo surgery for lower extremity fractures have substantial risk of chronic opioid use following surgery. Even the lowest rates of chronic opioid use identified in this meta-analysis are higher than opioid prescription rates reported in the general population, and pre-admission opioid use is common in patients with orthopedic injuries, which may further influence chronic usage. It is important that orthopedic surgeons and affiliated healthcare professionals become aware of this risk and implement tailored pain-management protocols to decrease opioids after lower extremity trauma.

Paper 121

Sex- and Age-Based Differences in Outcomes and Survivorship Following Primary Hip Arthroscopy at Short and Mid-Term Follow-Up

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PURPOSE: To report minimum 2- and 5-year patient-reported outcome scores (PROs) and survivorship according to sex and age in patients following primary hip arthroscopy for femoroacetabular impingement syndrome (FAIS).

METHODS: Data from February 2008 to September 2018 were reviewed. Patients aged ≤ 60 years old who underwent primary hip arthroscopy with minimum 2-year follow-up were included. Exclusion criteria were Tönnis grade > 1 , hip dysplasia, and previous hip conditions. Minimum 5-year PROs were also collected. Included patients were divided into groups by sex. Males and females were also stratified according to age: < 21 , 21–30, 31–40, 41–50, and 51–60 years old.

RESULTS: In total, 1,326 hips had minimum 2-year follow-up, including 860 (64.9%) females and 466 males (35.1%), with a mean age of 31.6 ± 12.5 years. Of those, 772 had minimum 5-year follow-up, 515 females (66.7%), and 257 males (33.3%), with a mean age of 31.7 ± 12.5 years. Patients showed significant improvements in PROs at minimum 2- and 5-year follow-up. Between sex analysis revealed comparable PROs at latest follow-up between females and males across age groups. Within sexes, and when sexes were combined, patients < 21 years old had significantly better outcomes compared to other age groups. There were more females < 21 years old that required revision arthroscopy than males < 21 years old. Conversion to total hip arthroplasty (THA) showed no significant difference between sexes.

CONCLUSION: Following primary hip arthroscopy for FAIS, all patients reported significant improvements in all PROs at minimum 2- and 5-year follow-up, with females and males achieving similar success. Age affected outcomes, with patients < 21 years old reporting better scores regardless of sex. Although the conversion rate to THA was similar between sexes, there was a positive correlation between age and THA rate.

Paper 122

Return to Sport and Minimum 2-Year Outcomes of Hip Arthroscopy in Elite Athletes with Coexisting Low Back Pain

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BACKGROUND: Patient-reported outcomes (PROs) and return to sport (RTS) after hip arthroscopy for femoroacetabular impingement syndrome (FAIS) have not been established in elite athletes with coexisting low back pain (LBP).

PURPOSE: (1) To report minimum 2-year PROs and RTS rate following primary hip arthroscopy for FAIS in elite athletes with coexisting low back pain and (2) to compare clinical results with a propensity-matched control group of elite athletes without back pain.

METHODS: Data were reviewed for elite (professional and college) athletes who underwent hip arthroscopy for FAIS and had coexisting LBP between October 2009 and October 2018. Inclusion criteria were preoperative and minimum 2-year follow-up for the modified Harris Hip Score (mHHS), Non-Arthritic Hip Score (NAHS), Hip Outcome Score-Sports Specific Subscale (HOS-SSS), and Visual Analog Scale (VAS) for pain. Exclusion criteria were Tönnis grade > 1, hip dysplasia (lateral center-edge angle < 18°), and previous ipsilateral hip or spine surgery/conditions. Rates of achieving the minimal clinically importance difference (MCID), patient acceptable symptomatic state (PASS), and maximum outcome improvement satisfaction threshold (MOIST) were recorded in addition to RTS. For the sub-analysis, the elite athlete study group was propensity-matched to an elite athlete control group without back pain.

RESULTS: A total of 48 elite athletes with low back pain who underwent primary hip arthroscopy met inclusion criteria, and follow-up was available for 42 (87.5%) at an average of 53.2 ± 31.6 months. Elite athletes with coexisting low back pain demonstrated significant improvements in all recorded PROs, achieved the MCID/PASS for the HOS-SSS at a rate of 82.5% and 67.5%, respectively, returned to sport at high rates (75.8%), and 79% did not report low back pain postoperatively. PROs, rates of achieving MCID/PASS for the HOS-SSS, and RTS rates were similar between the study and propensity-matched control group.

CONCLUSION: Elite athletes with coexisting low back pain who undergo primary hip arthroscopy for FAIS may expect favorable PROs, rates of achieving MCID/PASS for HOS-SSS, and RTS rates at minimum 2-year follow-up. These results were comparable to a propensity-matched control group of elite athletes without back pain.

Paper 123

Return to Sport and Testing Following Hip Arthroscopy For FAI in High School and Collegiate Athletes

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BACKGROUND: Femoroacetabular impingement (FAI) is a known cause of hip pain and dysfunction in young, active patients and can be successfully managed with hip preservation surgery. For athletes with FAI, however, there is inconsistent data regarding the ability to return to competitive sport after surgery and how performance level is impacted.

PURPOSE: To evaluate patient factors contributing to return to sport after hip preservation surgery.

STUDY DESIGN: Retrospective cohort

METHODS: We retrospectively reviewed patients aged 14 to 44 who underwent hip preservation surgery between December 2018 and May 2021 and who participated in a competitive or recreational sport preoperatively. All patients underwent formal return-to-sport (RTS) testing between 4 and 6 months after surgery. Patient-reported outcomes (PROs) were obtained at initial RTS testing using the International Knee (Hip) Documentation Committee (IKDC) questionnaire, Hip Outcome Score – Sports Specific Subscale (HOS-SSS), and Hip Return to Sport After Injury (Hip-RSI) scale. Regression analysis was performed to evaluate the relationship between RTS tests, PROs, BMI, pre- and postoperative alpha angles, and degree of correction. Degree of correction was the difference between pre- and postoperative alpha angles measured on Dunn view hip x-rays.

RESULTS: We identified 40 patients, 47 operative hips (34 females, 85%). Three patients (4 hips) were excluded for incomplete testing data. Mean age was 17.73 ± 2.7 years. All patients underwent hip arthroscopy for FAI including one case of single-stage bilateral hip arthroscopy. The most common primary sports were dance (7), softball (6), and basketball (5). Mean alpha angles were $67.15 \pm 10.9^\circ$ preoperatively and $41.37 \pm 4.5^\circ$ postoperatively. Average time from surgery to first RTS testing was 26.79 ± 6.5 weeks (median 25.1 weeks). Mean HOS-SSS score at initial testing was 85.98 ± 11 . Posteromedial (PM) and posterolateral (PL) reach on Y-balance test demonstrated a moderately strong positive correlation with HOS-SSS score at initial testing (PM: $r = 0.54$, $p < 0.001$; PL: $r = 0.53$, $p < 0.01$). Composite Y-balance score also had a moderately strong positive correlation with HOS-SSS score ($r = 0.6$, $p < 0.01$). All other comparisons between PROs and RTS tests showed weak to no correlation. Similarly, there was weak to no correlation between time to initial RTS testing and BMI, preoperative alpha angle, or degree of correction.

CONCLUSION: Higher Y-balance scores at initial RTS testing are associated with improved PROs and perceived readiness to return to sport. This test can be easily incorporated into an assessment for safe return after FAI surgery; further prospective studies are warranted.

Paper 124

Minimum Two-Year Outcomes Of Staged Bilateral Hip Arthroscopy In The Context Of Femoroacetabular Impingement Syndrome

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BACKGROUND: Bilateral hip symptoms from femoroacetabular impingement (FAI) is a common finding in patients regardless of athletic involvement. Often times, patients and surgeons choose to stage bilateral hip arthroscopic surgeries.

PURPOSE/HYPOTHESIS: The purpose of this study is two-fold. (1) To compare minimum 2-year outcomes between patients who underwent staged bilateral hip arthroscopic surgery for FAI to a propensity-score matched unilateral hip arthroscopy control group and (2) investigate the impact of time between bilateral procedures on PROs. We hypothesized that after bilateral hip arthroscopy, the outcome improvements would be similar to that after unilateral hip arthroscopy and time duration between the bilateral surgeries would not affect the final outcome.

METHODS: Data were retrospectively collected on a consecutive series of patients who underwent primary hip arthroscopies at our institution from June 2008 to November 2017. Patients who underwent bilateral hip arthroscopy with minimum 2-year PROs for modified Harris Hip Score, Nonarthritic Hip Score, Hip Outcome Score-Sports-Specific Subscale, patient satisfaction, and visual analog scale for pain were included. The bilateral cohort was matched 1:1 to a control group that only required unilateral hip arthroscopy based on age, sex, and body-mass index (BMI). Additionally, a subanalysis was performed on the study cohort to determine the impact of time between arthroscopies. Rates of achieving the minimal clinically importance difference (MCID) and patient acceptable symptomatic state (PASS) for mHHS and HOS-SSS were determined. The P value was set at .05.

RESULTS: 205 patients (410 hips) were included. The mean age and BMI in the study cohort were 32.3 ± 13.2 years and 25 ± 5.1 kg/m², respectively. All 410 hips that met the inclusion criteria were matched. There were no significant differences in demographic radiographic, or procedural data. Significant and comparable improvement was reported for all PROs and VAS ($P < .0001$) in both groups. Similarly, rates of achieving MCID and PASS were comparable. After dividing the bilateral cohort based on whether their contralateral procedure was performed less than or more than 3 months after their first surgery, it was determined that patients achieved significant improvement and favorable outcomes regardless of time between bilateral hip arthroscopies.

CONCLUSION: Patients who underwent unilateral and bilateral hip arthroscopic surgery for FAI achieved similar improvement in PROs at minimum 2-years' follow-up. After further dividing the bilateral cohort by time between procedures, the < 3-month group and > 3-month group demonstrated comparable outcomes.

Paper 125

Outcomes Following Hip Arthroscopy In Patients With Global Acetabular Retroversion: Male Gender And Competitive Athletes Are Associated With Better Outcomes

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INTRODUCTION: Treatment of hips with global acetabular retroversion (GAR) is challenging. Controversy exists whether arthroscopic surgery or corrective pelvic osteotomies are more appropriate in this patient population. The purpose was to investigate pain and function among patients with GAR treated with hip arthroscopy. In addition, to identify correlation between radiographic measurements, athlete status, return to play, and patient reported outcomes (PROs) postoperatively.

METHODS: Retrospective review of patients with GAR who underwent arthroscopic femoroacetabular impingement (FAI) surgery at a single institution was performed. GAR was defined by three radiographic criteria: crossover sign, ischial spine sign, and posterior wall sign on a well-positioned anteroposterior (AP) pelvic radiograph. Radiographic measurements included lateral center edge angle, anterior wall index, posterior wall index, alpha angle, and femoral version (measured with 3D CT). Demographics included age, gender, BMI, athlete status, return to play, and reoperation. PROs included modified Harris Hip Score (mHHS), visual analog scale (VAS), and Veterans Rand-12 (VR-12), in addition to others. Spearman coefficients determined any correlation of radiographic measurements, athlete status, and return to play with PROs. Significance was set at $p = 0.05$.

RESULTS: Between 2013 and 2019, 149 patients (65.00% female) with 160 hips with FAI and GAR underwent hip arthroscopy. At final follow-up, all PROs demonstrated significant improvement from preoperative ($p < 0.05$), except for VR-12 Mental. Males scored significantly higher on all postoperative PROs except VR-12 Mental. Females demonstrated higher pre- and postoperative VAS scores ($p < 0.05$). Those with femoral version $< 5^\circ$ had significantly higher HOS ADL, HOS Sport, and HOOS Sport scores than those with greater femoral version. No other radiographic measure correlated with PROs, athlete status, or return to play. Athletes reported lower preoperative VAS scores, and higher pre- and postoperative mHHS, HOS Sport, HOOS Daily Living, and VR-12 Physical scores ($p < 0.05$). Nine hips (5.63%) underwent reoperation.

DISCUSSION: In patients with GAR and FAI treated with hip arthroscopy, male patients and athletic patients had superior outcomes. Radiographic measurements did not correlate with outcomes, with the exception of low femoral version in a small subset. Athletes reported lower preoperative pain scores and had higher postoperative outcome scores than non-athletes in several PROs. Few required reoperations.

Paper 126

Radiofrequency Probe Design Influences Traction Duration and Surgical Time For Hip Arthroscopy

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INTRODUCTION: The learning curve of hip arthroscopy is significant, with outcomes dependent on patient selection and surgical technique. Moreover, surgery is constantly changing with innovations for surgical techniques and instruments. The purpose of this study was to compare traction time and surgical time during the first 50 hip arthroscopy cases using two different bipolar radiofrequency plasma ablation (coblation) wands. It was hypothesized that a wand design with increased thickness and surface area for coblation would result in decreased traction and surgical times.

METHODS: A single surgeon retrospective case series was performed on the first 50 cases using two different coblation wands from the same industry manufacturer. Wand A is a 50-degree angled probe with a tip and shaft diameter of 3 mm. Wand B is a 50-degree angled probe with a tip and shaft diameter of 4.7 mm. The patient cohort consisted of male and female patients of any age or diagnosis who had undergone primary or revision arthroscopic surgery of the central, peripheral, peritrochanteric, and/or deep gluteal space compartments. Surgical indications included Femoroacetabular Impingement (FAI) Syndrome, labral tear, peritrochanteric, or deep gluteal space diagnoses that had failed three months of nonsurgical treatment and had a minimum follow-up of one year. Hip arthroscopy was performed with patients in the supine position and traction was achieved using a well-padded perineal post.

RESULTS: There was no difference in the mean age of patients in the wand A cohort (30 females, 20 males) at 35.2 (range 14-75) years compared to 32.7 (range 14-58) years for the wand B cohort (31 females, 19 males) ($p = 0.16$). The mean surgical time using wand A compared to wand B was significantly more (118 ± 17 minutes vs. 102 ± 13 minutes, $p < 0.0001$). The mean traction time was also significantly more using wand A compared to wand B (51 ± 18 minutes vs. 41 ± 6 minutes, $p < 0.0001$). The two groups were similarly complex in the number of anchors used with wand A compared to wand B (3 ± 0.8 vs. 3.08 ± 0.9 , $p = 0.32$), as well as the number of CPT diagnosis codes utilized (5.5 ± 1.2 vs. 5.2 ± 1.4 , $p = 0.12$).

CONCLUSIONS: Less operative and traction times are associated with use of wand B over wand A, supporting the authors' hypothesis that increased surface area for radiofrequency ablation and increased girth enable the coblation wand to be more efficient during hip arthroscopy.

Paper 127

Post-Related Complications in Prospective vs. Retrospective Hip Arthroscopy Evidence - If You Want To Know The Answer, You Have To Ask The Question, A Priori - A Systematic Review

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INTRODUCTION: Complications associated with the use of a perineal post during hip arthroscopy include pudendal nerve pathology and compression-related genitourinary and gynecologic soft tissue injuries. Due to the sensitive nature of groin-related nerve and soft-tissue injuries, these complications may be unreported by patients and unqueried by surgeons. Postless hip arthroscopy is a meaningful innovation that may reduce or eliminate perineal complications associated with post-assisted surgery. The purposes of this investigation are to determine if there are differences in: 1) the incidence of post-related complications following hip arthroscopy between prospective and retrospective publications; and 2) between post-assisted and postless techniques.

METHODS: A systematic review was performed using PRISMA guidelines to characterize post-related complications (pudendal nerve, perineum/external genitalia soft tissue) following hip arthroscopy for central or peripheral compartment hip pathology, including FAI (Femoroacetabular Impingement) Syndrome, and chondrolabral injury. Inclusion criteria were prospective and retrospective, level I-IV evidence investigations that reported results of hip arthroscopy performed in the supine position. Exclusion criteria included open or extra-articular endoscopic hip surgery. Post-related complications included pudendal nerve injury (sexual dysfunction, dyspareunia, perineal pain, or numbness) or perineal skin injury.

RESULTS: Ninety-six studies (12,479 hips; 49% male, 51% female; 52% level IV evidence) were analyzed. Prospective studies (3,032 hips) report a higher incidence of post-related complications compared to retrospective (8,383 hips) studies (7.1% vs. 1.4%, $p < 0.001$). Three studies utilized a postless technique and all reported a 0% incidence of pudendal neurapraxia or perineal soft tissue injury. Most pudendal nerve complications were transient, resolving by 3 months, but permanent nerve injury was reported in 4 cases. Only 19%, 22%, 7%, and 4% of studies reported a total surgery time, traction time, traction force, and bed Trendelenburg angle for their study samples, respectively.

CONCLUSION: The incidence of post-related complications is five times greater in prospective (vs. retrospective) hip arthroscopy literature. Postless distraction results in a lower incidence of post-related injuries, essentially eliminating their risk.

Paper 128

High-Level Athletes With A High BMI Demonstrate Inferior Outcomes Compared To High-Level Athletes With A Normal BMI

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BACKGROUND: The impact of high BMI (Body Mass index) on outcomes in athletes has not been established.

PURPOSE: (1) To report minimum 2-year patient-reported outcome scores (PROs) and return to sport (RTS) for high-level athletes with high BMI undergoing hip arthroscopy for femoroacetabular impingement syndrome (FAIS) and (2) to compare results with a propensity matched control group of high-level athletes with a normal BMI.

METHODS: Data on all professional, collegiate, and high-school athletes who had a high BMI (> 30) and underwent primary hip arthroscopy for FAIS between January 2010 and December 2018 were collected. RTS status and minimum 2-year PROs were collected for the modified Harris Hip Score (mHHS), Non-arthritic Hip Score (NAHS), Hip Outcome Score-Sport Specific Subscale (HOS-SSS), and visual analog scale (VAS) for pain. The percentage of patients achieving minimal clinically important difference (MCID) and patient acceptable symptomatic state (PASS) were also recorded. These patients were propensity matched in a 1:3 ratio to high level athletes with a normal BMI for comparison.

RESULTS: A total of 30 high-level athletes with high BMIs were included with a mean follow-up of 49.4 ± 29.5 months. They demonstrated significant improvement from preoperative to latest follow-up for mHHS, NAHS, HOS-SSS, and VAS ($P < .001$). When outcomes were compared to a propensity-matched control group of 90 athletes with normal BMI, high BMI athletes had worse acetabular cartilage injury and were more likely to undergo acetabular microfracture ($P < .001$). High BMI athletes demonstrated lower postoperative scores for NAHS ($P = 0.049$) and HOS-SSS ($P = 0.038$) compared to athletes with normal BMIs, but rates of achieving MCID/PASS for mHHS and HOS-SSS were similar between groups. High BMI athletes also returned to sport at a lower rate compared to athletes with normal BMI, but this did not reach statistical significance ($P = 0.251$).

CONCLUSION: Athletes with high BMIs undergoing primary hip arthroscopy for FAIS demonstrated significant improvement in PROs and acceptable rates achieving clinically meaningful improvement. When compared to a control group of high-level athletes with normal BMIs, they exhibited lower postoperative scores for NAHS and HOS-SSS.

Paper 129

Incidence and Treatment of Os Acetabuli in Femoroacetabular Impingement: A Systematic Review

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BACKGROUND: Os acetabuli, or acetabular rim fractures, are often seen in large cam-type femoroacetabular impingement (FAI). The true incidence, optimal treatment, and outcomes have not yet been fully characterized.

PURPOSE: To perform a systematic review of the incidence and treatment of os acetabuli in the setting of FAI.

METHODS: Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. PubMed, EMBASE, and Cochrane Central Register of Controlled Trials were queried for all English-language studies reporting presence of os acetabuli in the setting of either arthroscopic or open hip preservation surgery for FAI. Studies with or without patient-reported outcomes (PROs) were included as were studies reporting the radiographic incidence of rim fractures. Weighted means were calculated for age and follow-up length. Pooled radiographic and surgical incidence was calculated for patients with known FAI.

RESULTS: A total of 6,335 patients and 12,341 hips were identified (3,170 females, 50.04%) of which 660 hips were operative. The mean age was 32.15 ± 3.8 years. Four studies assessed the incidence of os acetabuli. The pooled radiographic and operative incidence in patients with known FAI were 13.5% (69 of 510 hips) and 11.5% (59 of 511 hips), respectively. Patient sex was specified in only 90 individuals. Of these patients, rim fractures were seen in 63 males (70%) and 27 females (30%). The incidence in males vs. females was not commonly reported in the present literature. For operative management, fragment excision was most frequently performed (94 of 95 cases, 99%). There was one case of internal fixation in our review. There are no identified case series of os acetabuli fixation in the present literature. Two studies reported PROs following operative management with a mean follow-up of 25.75 ± 3.5 months. In one study (21 hips), mean modified Harris Hip Score (mHHS) improved from 57.5 (39 to 82) to 95 (73 to 100) after fragment excision. mHHS for the patient treated with fixation improved from 39.6 to 100. The second study (21 hips) reported improved mean mHHS from 68.4 to 79.77 ± 16.69 . Mean Hip Outcome Score – Activities of Daily Living (70.6 to 81.19 ± 17.48) and Sport Specific Subscale (50.5 to 66.76 ± 28.83) also improved postoperatively.

CONCLUSION: Os acetabuli/rim fractures are uncommon in FAI; fragment excision is the most commonly reported treatment. There is no evidence in the present literature to support fragment fixation, an area that may require future clinical study.

Paper 130

Difference in Postoperative Pain between Two Techniques for Arthroscopic Hip Capsule Closure

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BACKGROUND: Capsular closure has been demonstrated to show improvements in outcomes following FAI treatment. Few studies have reported on techniques of arthroscopic capsule closure and how they impact postoperative pain.

PURPOSE: To evaluate the difference in postoperative pain scores between two arthroscopic hip capsule closure techniques.

STUDY DESIGN: Retrospective cohort

METHODS: We retrospectively reviewed postoperative visual analog scale (VAS) pain scores from 200 patients who underwent hip arthroscopy for FAI by a single surgeon. In 100 cases, the capsule was closed from within the joint without disrupting the attachments of the iliocapsularis or gluteus minimus muscles. In 100 cases, these attachments were released prior to closing the capsule from outside the hip joint. For each cohort, we calculated the mean postoperative pain scores at the following time points: first post-anesthesia care unit (PACU) score, final PACU score, and discharge score. We also compiled mean preoperative, intraoperative, postoperative, and total morphine milligram equivalents (MME) for each group.

RESULTS: The mean age was 27.29 ± 10.3 years (126 females, 63%). In the extra-capsular hip group, the mean first PACU, final PACU, and discharge VAS pain scores were 6.16 ± 2.7 , 4.21 ± 1.6 , and 3.53 ± 1.6 , respectively. The intra-capsular hip scores were 5.54 ± 3.1 , 4.18 ± 2 , and 3.34 ± 1.9 , respectively. There was no difference between the groups at any time point ($p = 0.11$, $p = 0.91$, $p = 0.43$). On average, the intra-capsular group received significantly more MME intraoperatively (29.84 vs. 24.87, $p = 0.014$) and more total MME (63.43 vs. 58.15, $p = 0.0497$) than the extra-capsular group. There was no difference in preoperative ($p = 0.69$) or postoperative mean MME ($p = 0.97$). At 1 year, there was a 1% revision rate (2 PATIENTS: 1 subsequent sub-spine resection, 1 labral reconstruction); capsule-labral adhesions were present in 1 case (0.5%).

CONCLUSION: There is no apparent difference in postoperative pain scores or revisions for capsular issues or adhesions when comparing these two capsule closure techniques.

Paper 131

Sex Differences in Outcomes following Surgical Management of FAI and Dysplasia: A Systematic Review and Meta-Analysis

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BACKGROUND: Female patients undergoing hip preservation surgery often have lower postoperative patient-reported outcome scores (PROs), causing concern regarding the likelihood of clinical benefit in women.

PURPOSE: To perform a systematic review and meta-analysis comparing preoperative and postoperative PROs, and change in PROs, for female vs. male hip preservation patients.

STUDY DESIGN: Systematic review

RESULTS: We identified 32 hip preservation studies discussing gender vs. PRO differences, and/or providing gender-specific PRO data. The quantitative analysis of 26 studies (2,301 patients) was stratified by developmental hip dysplasia (DDH) status. The modified Harris Hip Score (mHHS), Hip Outcome Score Activities of Daily Living subscale (HOS-ADL), and Hip Outcome Score Sport-Specific subscale (HOS-SSS) were assessed.

Patients undergoing surgery for Femoroacetabular impingement (FAI) only were 76.37% female (n = 1,270/1,663). Men averaged higher preoperative HOS-ADL (70.06 ± 10.26 vs. 63.40 ± 5.63 , $p < 0.05$) and HOS-SSS (48.29 ± 7.82 vs. 40.79 ± 3.72 , $p < 0.05$) scores; and postoperative mHHS (86.65 ± 7.08 vs. 83.19 ± 6.60 , $p < 0.05$), HOS-ADL (90.20 ± 5.48 vs. 89.40 ± 5.87 , $p < 0.05$), and HOS-SSS (81.50 ± 7.92 vs. 79.12 ± 6.70 , $p < 0.05$) scores. Men had more improvement of mHHS (26.74 ± 0.61 vs. 22.88 ± 0.22 , $p < 0.05$), but not HOS-ADL (20.14 ± 4.41 vs. 26.00 ± 0.35 , $p < 0.05$) or HOS-SSS (33.21 ± 0.71 vs. 38.33 ± 0.46 , $p < 0.05$).

Patients undergoing surgery for DDH with or without concurrent FAI were 90.44% female (n = 577/638), with adequate mHHS data only. Women averaged lower preoperative mHHS scores (66.29 ± 8.55 vs. 72.25 ± 10.90 , $p < 0.05$), but higher postoperative scores (88.97 ± 6.50 vs. 82.85 ± 3.39 , $p < 0.01$). Women had more improvement of mHHS (22.68 ± 0.45 vs. 10.60 ± 1.46 , $p < 0.01$).

CONCLUSIONS: The present review suggests that men undergoing surgery for FAI and/or DDH have higher postoperative PRO scores. However, when taking into account preoperative to postoperative PRO score changes, women may actually have a larger amount of symptomatic improvement after surgery compared to men. This finding is strongest in surgical treatment of DDH.

Paper 132

Modified Loop Suture Technique in Arthroscopic Labral Repair of the Hip

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BACKGROUND: Arthroscopic labral repair of the hip joint is a procedure that is increasing in popularity. As such, labral repair techniques are still evolving. Here we present a novel technique for suture repair: the modified loop repair.

DESCRIPTION OF TECHNIQUE: Standard arthroscopic access to the hip joint is established with anterolateral (AL), mid-anterior (MA), and distal anterolateral accessory (DALA) portals. The acetabular rim is prepared to bleeding bony surface. Suture anchors are placed along the prepared rim through the DALA portal. A suture passer is used to shuttle sutures out through a cannula in MA portal. One limb of suture is grasped with suture passer. Slack is created in this limb by either past-pointing it into the central compartment or withdrawing it into the canula. The suture is then passed through the chondrolabral junction into central compartment, where it is released. The suture passer is retracted through the chondrolabral junction.

These steps have created a modified loop, which sits along the acetabular rim, just superior to the labrum. The suture passer is placed through this loop and then then advanced into the central compartment where it grasps the suture limb previously passed through the chondrolabral junction. This suture is then retracted back through the loop and out through the cannula.

This has created a locking suture loop that can be tightened to the anchor by pulling on the opposite end of the suture. This technique is finished with standard half-hitch knots being tied using the opposite suture as the initial post.

RESULTS: The modified loop suture passing technique is an effective means of suture passing for labral repair. By utilizing this technique, the labrum can be tightly locked, knots can be placed away from the edge of the labrum and avoids eversion of the labrum. These advantages allow for a strong repair and restoration of the suction seal of the hip.

CONCLUSIONS: The modified loop suture passing technique for arthroscopic hip labral repair allows for a high-quality restoration of the suction seal in labral repair. It can be a valuable tool in the armamentarium of the hip arthroscopist.

Paper 133

Outcomes of Arthroscopic Decompression of the Anterior Inferior Iliac Spine: A Systematic Review and Meta-Analysis

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BACKGROUND: Anterior inferior iliac spine (AIIS) impingement has been increasingly recognized as a source of extra-articular hip pain. However, no aggregate data analysis of patient outcomes after AIIS decompression has been performed.

PURPOSE: To perform a systematic review and meta-analysis of outcomes after arthroscopic AIIS decompression including indications, patient-reported outcomes (PROs), complication rates, and revision rates.

METHODS: Using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, we queried PubMed, EMBASE, and Cochrane Central Register of Controlled Trials for English-language studies reporting outcomes of arthroscopic AIIS decompression performed in isolation or with hip preservation surgery. Studies with a minimum 6-month mean follow-up were included. Indications for AIIS decompression were recorded. Pooled estimates were calculated for the percentage of patients who underwent AIIS decompression and other concomitant procedures. Weighted means were calculated for age, length of follow-up, PRO measures, complication rates, and revision rates.

RESULTS: A total of 547 patients and 620 operative hips (311 females, 57%) were identified. The mean age was 28.42 ± 5.6 years, and the mean follow-up was 25.22 ± 11.1 months. Eight of 10 studies evaluated outcomes of patients who were indicated for AIIS decompression in the setting of primary hip arthroscopy for femoroacetabular impingement (502 hips, 81%). Weighted mean improvements in the modified Harris Hip score (mHHS), Hip Outcome Score Activities of Daily Living (HOS-ADL) and Sport-Specific Subscale (HOS-SSS) were 27.4 ± 5.7 , 24.0 ± 8.0 , and 46.0 ± 18.2 , respectively (all $p < 0.01$). The pooled risk of postoperative complications was 1.1% (95% CI 0.1 – 2.1%), and the pooled risk of needing revision surgery was 1.0% (95% CI 0.1 – 2.0%). No complication was directly attributed to the AIIS decompression portion of the procedure.

CONCLUSION: All patient-reported outcomes improved significantly after arthroscopic AIIS decompression with a low risk of postoperative complications and revision surgeries.

Paper 134

Deep Learning Tool for Accurate and Precise Automatic Measurement of Femoral Component Subsidence Following Total Hip Arthroplasty from Plain Radiographs

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INTRODUCTION: Femoral component subsidence following total hip arthroplasty (THA) is a worrisome radiographic finding. This study introduces a deep learning tool to automatically identify and quantify femoral component subsidence between two serial anteroposterior (AP) radiographs.

METHODS: A deep learning model was trained to automatically segment femur, implant, and magnification markers on a dataset of 700 AP hip radiographs. Primary THA utilizing polished tapered cemented femoral stems were chosen given their design to undergo subtle, controlled subsidence. We then developed an image processing algorithm to measure subsidence by automatically annotating reference points on the femur and implant that adjusted for magnification and rotation. We subsequently compared algorithm and manual subsidence measurements by two independent orthopedic surgeon reviewers on 135 patients.

RESULTS: The deep learning tool quantified subsidence as small as 0.1 mm. Among 135 cases, 96 had documented subsidence of ≥ 0.1 mm (range: 0.1 mm - 14.0 mm). The mean, median, and the standard deviation of measurement discrepancy between the automatic and manual measurements were 0.6 mm, 0.3 mm, and 0.7 mm, respectively. An app version of the tool annotated radiographs and quantified subsidence in <12 seconds per patient.

CONCLUSION: This deep learning tool demonstrates capacity to measure subtle femoral component subsidence as small as 0.1 mm on serial AP hip radiographs without any human annotation. Performance metrics indicate highly accurate and precise measurements compared to human annotation, with very infrequent clinically relevant discrepancies. As such, it can flag "implants of concern" that should undergo higher scrutiny review by orthopedic surgeons and radiologists. The tool has both clinical and research applications and may improve THA surveillance and earlier detection of impending component failure.

Paper 135

Preoperative Digital Templating for Primary Uncemented Total Hip Arthroplasty Proves Consistently Accurate Over a 4 Year Period

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BACKGROUND: Preoperative planning for total hip arthroplasty (THA) reduces surgical errors and improves patient outcomes. Previous studies have investigated templating accuracy and variables which may affect template and implant size agreement. However, conclusions drawn from these studies have varied. The aims of our study included measuring overall template accuracy in the setting of primary uncemented THA, investigating clinical and demographic factors that may affect templating accuracy, and determining if a single operator could improve their templating accuracy over time.

MATERIALS & METHODS: 491 primary THA cases performed by a single surgeon were digitally templated using ORTHOVUE (Jacksonville, FL). Template and implant component sizes were compared. Accuracy was defined as within ± 1 size. Procedures were grouped by manufacturer, side of operation, sex, BMI, year, and first and second halves to investigate potential factors influencing digital template accuracy. Mann-Whitney U and Kruskal-Wallis with paired post-hoc tests were used for statistical analysis.

RESULTS: Overall accuracy, defined as within \pm one size, was 83.7% and 69.8% for acetabular and femoral components respectively. Template accuracy was not significantly different amongst investigated clinical and demographic variables. Template accuracy was not significantly different between years. With dividing consecutive cases into first and second halves, we found no significant differences in templating accuracy.

CONCLUSIONS: Digital templating is an effective and accurate tool used for preoperative planning of uncemented primary THA. Accuracy of digital templating was consistently accurate over time, and accumulating experience with its use did not have any significant effect on the achieved accuracy rates throughout the study period.

Paper 136

Is Radiographic Malseating of Modular Dual-Mobility Liners Associated with Tribocorrosion Damage in Total Hip Arthroplasty?

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INTRODUCTION: As most modular dual mobility (DM) bearings have a junction between a Co-Cr liner and titanium shell, the risk of tribocorrosion at this interface remains a concern. The purpose of this study is to determine whether radiographic liner malseating is associated with liner tribocorrosion.

METHODS: Seventeen retrieved modular DM implants with a mean in-situ duration of 14.1 months (range 1-83) were evaluated. Two manufacturers were included (11 and 6 liners, respectively). Liners were considered malseated if a distinct divergence between the liner and shell was present on postoperative radiographs. Taper tribocorrosion was analyzed qualitatively with the modified Goldberg Score (mGS) and quantitatively with an optical coordinate-measuring-machine (CMM).

RESULTS: Four implants (23%) had severe grade 4 tribocorrosion, two (12%) moderate grade 3, eight (47%) mild grade 2, and three (18%) grade 1 or no visible tribocorrosion based on mGS. Longer in-situ duration positively correlated with increased mGS ($r = 0.83$, $p < 0.001$) and volumetric material loss caused by wear and corrosion ($r = 0.64$, $p = 0.007$). There was no difference in volumetric material loss between the two manufacturers (0.14 vs. 0.0 mm³, $p = 0.21$).

Malseating occurred in 5 of 11 liners from manufacturer A and 0 of 6 liners from manufacturer B ($p = 0.10$). Malseated components had a longer mean in-situ duration (36.8 vs. 4.6 months, $p = 0.002$) and greater volumetric material loss (0.298 vs. 0.005 mm³, $p = 0.003$), with no significant difference in mGS. However, multiple linear regression modeling did not show in-situ duration ($p = 0.12$) or malseating ($p = 0.32$) to be independently associated with volumetric material loss.

CONCLUSION: While malseated liners were associated with greater volumetric material loss, in our series they also had a longer mean in situ duration. Thus, the independent association of malseating on liner tribocorrosion is still unclear. While 35% of liners possessed severe or moderate tribocorrosion, longitudinal studies are required to determine its clinical significance.

Paper 137

Biomarkers of Compromised Implant Fixation, Following Total Hip Arthroplasty

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INTRODUCTION: Aseptic loosening secondary to particle-induced osteolysis is a major complication of total hip arthroplasty (THA), accounting for up to 70% of revision procedures. Continuous generation of implant wear particles and persistence of proinflammatory molecules in the peri-implant area alters normal bone homeostasis to favor resorption, ultimately compromising implant fixation. Imaging modalities are not considered accurate and often fail to detect osteolysis early enough to intervene non-surgically. Detection of circulating molecular biomarkers has been suggested as an improved method for identifying those at risk of osteolysis.

METHODS: We searched several online databases for current reports of osteolysis biomarkers. Using illustrated figures and diagrams, we aim to provide hip surgeons with the knowledge and evidence of the sensitivity and specificity of molecular biomarkers in early osteolysis detection and inform which perioperative measures should be considered to improve the osteointegration of implanted hardware.

RESULTS: Several biomarkers are associated with distinct initial stages of particle disease and demonstrate promise as practical biomarkers in identifying and managing aseptic hip loosening. These include markers of inflammation such as TNF- α interleukins 1 β , 6, and 8, markers of bone turnover including C-terminal telopeptide of type I collagen, serum cross-linked N-terminal telopeptide, procollagen I N-terminal propeptide, cathepsin K, type III procollagen peptide, osteocalcin, tartrate-resistant acid phosphatase type 5b, and bone alkaline phosphatase, and markers of oxidative stress such as inducible NOS. There has been a great variability in the reported use of these biomarkers. Most existing studies are case control studies investigating few biomarkers with small sample sizes. As a result, increased attention is being given to perioperative measures that improve osteointegration of implanted hardware. Preoperative measures include bioactive coating (such as hydroxyapatite, bone marrow stromal cells, bone morphogenetic protein, biophysical stimulation (such as Pulsed Electromagnetic fields and Low intensity Pulsed Ultrasound (LIPUS)), manipulation of implant surface topography via plasma spraying, hydroxyapatite coating, sand blasting, acid etching, alkali heat treatment, and ion implementation, and choice of porous metals; intraoperative measures depend on the surgical approach, bone to stem ratios, and implant size; postoperative measures include rehabilitation as well as proper pharmacological management of pain and enhanced bone growth.

CONCLUSION: Molecular biomarkers are essential in studying aseptic loosening, not only because aseptic loosening manifests silently early in the disease course, but also because molecular biomarkers can optimize pre-, intra-, and postoperative measures in THA.

Paper 138

Impact of Transitioning to Mepivacaine from Bupivacaine Spinal Anesthesia in Anterior-Approach Total Hip Arthroplasty at a Free-Standing Ambulatory Surgery Center

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INTRODUCTION: Mepivacaine spinal anesthetic may facilitate more rapid postoperative recovery in joint arthroplasty than Bupivacaine. This study compares recovery, pain, and complications between the two anesthetics in anterior-approach total hip arthroplasty (THA) at a free-standing ambulatory surgery center (ASC) with the hypothesis that Mepivacaine will safely decrease time to same-day discharge (SDD).

METHODS: This retrospective cohort study of 282 consecutive patients with mean age 55.7 ± 8.8 years and body mass index 30.6 ± 5.3 who underwent THA at an ASC from November 2018 to July 2020 compares Bupivacaine (n = 141) vs. Mepivacaine (n = 141) spinal anesthesia, a transition made in March 2019. There were no other changes in perioperative protocols during this time. The main outcomes were length of stay in the postoperative unit (PACU) prior to SDD, time to controlled void and ambulation. Secondly, postoperative pain scores (0-10) with morphine equivalents required, use of bethanechol for delayed urination and any postoperative complications were compared. Statistical analysis included t-test, Fisher's exact test and analysis of variance (ANOVA).

RESULTS: Mepivacaine decreased mean PACU stay (4.0 vs. 5.7 hours, $p < 0.001$), time to void (3.1 vs. 4.9 hours, $p < 0.001$), ambulation (3.2 vs. 4.5 hours, $p < 0.001$) and total facility time (7.0 vs. 8.8 hours, $p < 0.001$). More patients required bethanechol for in the Bupivacaine than Mepivacaine group (38.3% vs. 19.1%, $p < 0.001$). No patients needed urinary catheterization or overnight stay. Two patients in the Bupivacaine group had transient neurologic symptoms, consisting of foot drop and spinal headache, compared to none with Mepivacaine ($p = 0.498$). Mepivacaine patients had increased postoperative pain at 2 hours (1.7 vs. 0.9, $p < 0.001$), at discharge (1.1 vs. 0.5, $p = 0.004$) and morphine equivalents received (7.8mg vs. 3.7mg, $p < 0.001$).

CONCLUSION: Mepivacaine spinal anesthesia for anterior-approach THA safely facilitated more rapid SDD from a free-standing ASC through decreased times to controlled void and ambulation with only minor increase in pain when compared to Bupivacaine.

Paper 139

Causes of Early Hip Revision Vary by Age and Sex: Analysis of Data From a Statewide Quality Registry

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INTRODUCTION: While THA is extremely successful, early failures do occur. The purpose of this study was to determine the cause of revision in specific patient demographic groups at three timepoints to improve quality. The data should guide treatment regimens and implant choice.

METHODS: Data for cases performed between 2012 and 2018 from a statewide, quality improvement arthroplasty registry was used. The database included 79,205 THA cases and 1,433 revisions with identified etiology (1,584 total). All revisions performed at < 5 years from the primary THA were reviewed. Six groups: men/women, <65, 65-75, and >75 years, were compared at revision timepoints <6 mo, <1 year, and <5 years.

RESULTS: There were obvious and significant differences between subgroups based on demographics and timepoints ($p < .0001$). The most common etiologies within 1 year (961 revisions) were: fracture (324, 33.7%), dislocation (235, 24.5%) and infection (164, 17.0%). 756 (78%) of the 1-year revisions occurred within 6 months, the vast majority within 6 weeks. At this early timepoint, the most common revision cause was fracture for all groups and ages (316, 42%) ranging from 27.6% in young men to 60% in older women. Joint instability became the leading cause for revision after 6 months in younger women whereas for younger men infection became the primary issue. The most striking finding was the incidence of fracture as the leading cause of revision at all time points for both men and women >75 years.

CONCLUSION: This quality project demonstrated clinically significant differences in the reason for THA revision between gender, age, and time from surgery. Strategies based on these data should be employed to minimize the factors that lead to revision. For example, cementing stems to avoid fractures in older patients and maximizing joint stability via technique or implant in younger women.

Paper 140

Monoblock Fluted Tapered Stems: How Do They Compare to Modular Fluted Tapered Stems?

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INTRODUCTION: Modular fluted tapered stems (MFT) have proven highly successful in revision total hip arthroplasty (THA), however, concerns remain regarding the potential for modular junction failure. Concurrently, there has been a resurgence in the use of monoblock fluted tapered stems. The goals of this study were to compare the survivorship, radiographic results, and clinical outcomes of monoblock stems to a matched cohort of modular stems.

METHODS: We retrospectively identified 60 aseptic revision THAs performed using a monoblock fluted tapered stem (Wagner SL) from 2015-2018 via our institutional total joint registry. Patients were 1:1 matched according to age, sex, BMI, surgical year, and femoral bone loss with patients treated with one of two modular stems. Mean age was 70 years, mean BMI was 29 kg/m², and 50% were female. Femoral bone loss was classified as Paprosky Type I in 35%, Type II in 47%, Type IIIA in 17%, and Type IV in 2%. Survivorship free of any revision was assessed via Kaplan-Meier methods, and Harris hip scores (HHS) were analyzed. Mean follow-up was two years.

RESULTS: Survivorship free of any revision was 100% in the monoblock group vs. 94% in the modular group ($p = 0.1$). Indications for modular stem re-revision included infection (2) and femoral loosening (1). Subsidence >5 mm was noted in 7 hips from each group ($p > 0.99$), including the revised modular stem. All other stems were radiographically well-fixed. Mean HHS similarly improved from preoperatively to most recent follow-up in both the monoblock (54 to 79) and modular (63 to 82) groups ($p = 0.62$).

CONCLUSION: At short-term follow-up, equivalent results were seen between monoblock and modular fluted tapered stems used in aseptic revision THA. While reassuring, longer term follow-up is needed to assess for differences in durability, particularly in those cases with substantial bone loss.

Paper 141

Patient Satisfaction following Total Joint Arthroplasty Before and During the COVID-19 Pandemic

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INTRODUCTION: The COVID-19 pandemic had an unprecedented impact on the inpatient experience before and after total joint arthroplasty (TJA). Many surgeries were delayed or scheduled as outpatient, and stricter isolation policies led to decreased human interaction during admission. The Hospital Consumer Assessment of Healthcare Providers and Services (HCAHPS) survey is provided to a random sample of hospital discharges to assess patient satisfaction, consisting of closed-ended questions (Likert scale ratings) and an open-ended comment section. The goal of this study is to examine how these changes impacted patient satisfaction following TJA as recorded by HCAHPS post-discharge surveys at two geographically different academic hospitals.

METHODS: A retrospective review was conducted identifying patients who completed HCAHPS surveys following discharge for primary and revision TJA at a tertiary academic hospital in a predominately rural southern state (Institution A) and a large academic hospital system in a northeastern metropolitan city (Institution B). Patients were grouped depending on discharge date: pre-COVID (April 1, 2019, to October 31, 2019) or COVID-affected (April 1, 2020, to October 31, 2020). Differences in demographics, quantitative survey responses, and open-ended comment sentiments and themes detected by qualitative analysis were collected and evaluated using chi-square tests.

RESULTS: The number of question responses to HCAHPS surveys decreased at both institutions from the pre-COVID period to the COVID period (Institution A, 1,038 vs. 974, Institution B, 9,348 vs. 5,297). The proportion of top-box survey responses did not change for any question at either institution across the two periods. While the number of open-ended comments decreased at institution B (1,977 vs. 1,012), Institution A saw an increase (55 vs. 88). During the COVID-affected period, there was a significant increase in the proportion of negative comments from Institution B (11.6% vs. 14.8%, $p = 0.013$), but not Institution A (20.0% vs. 13.2%, $p = 0.268$). There was a significant decrease in the number of positive comments from Institution A between the two periods (70.9% vs. 44.3%, $p < 0.001$), but not from Institution B (53.4% vs. 52.7%, $p = 0.728$).

CONCLUSION: This study analyzed HCAHPS survey responses and comments from two institutions in different regions of the country. A negative change in patient sentiments following TJA during the COVID-19 pandemic was seen in qualitative comments, but not quantitative responses. This suggests that aspects of the TJA patient experience affected by COVID-19 including visitor policies, changes to nurse staffing ratios, increased outpatient surgery, and other restrictions had a measurable impact on satisfaction following TJA.

Paper 142

The Fragility Index of Total Hip Arthroplasty Randomized Control Trials: A Systematic Review

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INTRODUCTION: Although randomized controlled trials (RCTs) are considered the gold standard study design, a change of outcomes for a few patients can lead to a reversal of study conclusions. As such examination of the fragility index (FI) of RCTs has become an increasingly popular method to provide further information regarding the relative robustness of RCT results. The purpose of this study was to systematically characterize and assess the predictors of the FI RCTs in total hip arthroplasty (THA) literature.

METHODS: PubMed/MEDLINE, Embase, and Cochrane were systematically searched for all THA RCTs published between January 2015 and December 2020 that had an equal assignment of participants to a two parallel arm study design, examined a surgical intervention, and reported on at least one statistically significant dichotomous outcome in the abstract. Potential factors associated with the FI were examined using the Spearman's correlation and Mann-Whitney U test.

RESULTS: Thirty-four RCTs were selected, with a median number of study participants of 111 [interquartile range (IQR) 72 – 171] and a median total number of events of 15 (IQR 9.5 - 29). The median fragility index was 2 (IQR 1 – 6), while six studies had a FI of 0. In 18 (52.9%) of the cases, the number of patients needed to change from “no event” to “event” was less than the loss to follow-up. Larger sample size was found to predictive a higher FI ($r_s = 0.367$, $p = 0.033$), but the year of publication, journal impact factor, the calculated power analysis size, and loss to follow-up were not associated with FI.

CONCLUSION: The FI serves as a useful addition to other more commonly used approaches of quantitative analyses, such as p-values, effect sizes, and confidence intervals, and widespread reporting the FI may provide clinicians with further information about RCT results.

LEVEL OF EVIDENCE: Level I, Systematic review of Level I studies.

Paper 143

A Retrospective Review of Relative Value Units in Revision Total Hip Arthroplasty: A Dichotomy Between Surgical Complexity and Reimbursement

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INTRODUCTION: Revision total hip arthroplasties (THA) are expensive, complex, and technically challenging procedures. There are concerns regarding the valuation (reimbursement) and the assigned relative value units (RVU, estimated level of work) for revision procedures. The purpose of this study was to evaluate the labor and time investment for each component-specific revision. We hypothesized that a disparity exists in procedural value billed and final reimbursement between primary and revision THAs.

METHODS: A retrospective review was performed to identify primary and revision THAs performed at our institution from 2015-2019. Patients were randomly selected from the following: primary THA, single femoral component revision, single acetabular component revision, liner and femoral head (head/liner) revision, all component (complete) revision, and spacer placement for prosthetic infection. Operative notes were reviewed to adjust for misattributed CPT codes. 165 cases met our inclusion criteria and were studied using internal billing data. Independent T-tests compared final reimbursement per minute and per RVU between revision and primary THAs.

RESULTS: The following procedures were performed: 27-primary THAs, 26-acetabular component revisions, 32-head/liner revisions, 26-femoral component exchanges, 27-complete revisions, and 27-spacer placements. On average, a primary THA resulted in a reimbursement of \$27.27 per minute. Each revision subgroup was found to result in less reimbursement dollars per minute compared to primary THA ($p < .05$). In addition, reimbursement in relation to total RVU per procedure was studied. A primary THA provided on average \$79.09 per RVU. Likewise, all revision subgroups were discovered to reimburse less per RVU compared to primary THAs ($p < .05$).

CONCLUSIONS: As revision complexity increases, physicians are reimbursed less per minute and per RVU compared to primary THA. With the current reimbursement model, surgeons may be less inclined to take on complex revision THAs due to financial pressures, further reinforcing the re-evaluation of the CPT system.

Paper 144

How Surgeon Experience affects Periprosthetic Fracture Rates Following Hip Replacement

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INTRODUCTION: The incidence of periprosthetic femur fracture (PFF) following total hip arthroplasty (THA) ranges from 0.1% to 4.1%. Surgical technique is known to affect the risk of fracture. Patient demographics, such as advanced age and female sex, and surgical implant design have been associated with higher rates of PFF. A previous study reported similar patient reported outcomes for surgeons of differing experience levels, however, the relationship between surgeon experience and PFF is unknown. We hypothesize surgeons with less surgical experience will have an increased rate of patients with PFFs.

METHODS: This was a retrospective cohort study of patients who underwent primary THA over a 6-year period with 1 of 33 surgeons with varying levels of experience. Patient's demographics, surgery date, surgeon, and surgical complications were collected via chart review. Surgeon experience was determined by the number of years in practice. PFF rates were compared between surgeons in group one (0-5 years of surgical experience), group two (5.01-15 years), and group three (> 15 years) using a 2x3 chi-square test, with statistical significance set to $p < .05$.

RESULTS: A total of 7,110 THAs were analyzed, 1,652 from group one surgeons, 2,987 from group two surgeons, and 2,471 from group three surgeons. 62 PFFs were identified. Group one surgeons had 17 PFFs (1.0%). Group two surgeons had 27 PFFs (0.9%). Group three surgeons had 18 PFFs (0.7%). No statistically significant relationship was found between years of surgeon experience and the rate of PFFs, $\chi^2 (2, N = 7,110) = 1.096$, $p = .578$. Female patients were four times more likely than male patients to develop a PFF (OR 4.32, 95% CI: 2.30-8.42).

CONCLUSION: There was a trend of decreasing PFF rate with increasing surgeon experience level, however, the differences were not statistically significant.

Paper 145

A Randomized Controlled Trial of Conventional and Modular Dual-Mobility Bearings- Are Serum Metal Levels a Concern?

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INTRODUCTION: Modular dual-mobility bearings in total hip arthroplasty (THA) have the proposed benefit of improved stability, but concerns of potential corrosion between the modular cobalt alloy acetabular liner and titanium shell remain. The purpose of this study was to prospectively evaluate serum metal ion levels in patients undergoing THA with either a standard or modular dual-mobility bearing.

METHODS: Patients undergoing primary THA for osteoarthritis were randomized to receive either a modular dual-mobility or a standard polyethylene bearing. All patients received the same titanium acetabular and femoral component and a ceramic femoral head. Only patients without a prior history of metal implants in their body were eligible for inclusion, thus isolating serum metal ions to the prosthesis itself. Serum metal ion levels were drawn preoperatively and at one year postoperatively. Power analysis determined that 40 patients (20 in each group) were needed to identify a clinically relevant difference in serum cobalt of 0.35 ng/ml (ppb) at 90% power assuming a pooled standard deviation of 0.31 ppb and $\alpha = 0.05$; an additional 30% were enrolled to account for potential dropouts.

RESULTS: 53 Patients were enrolled, with 21 patients in the modular dual-mobility group and 17 in the standard cohort with data available at one year. No differences in the serum cobalt (0.17 ng/ml (ppb) [range 0.06 to 0.28] vs. 0.22 ng/ml (ppb) [range 0.00 to 0.44], $p = 0.53$, $SD = 0.11 \pm 0.22$) or chromium levels (0.19 ng/ml (ppb) [range 0.03 to 0.35] vs. 0.16 ng/ml (ppb) [range 0.01 to 0.31], $p = 0.31$, $SD = 0.16 \pm 0.16$) were identified.

DISCUSSION: At one-year postoperatively, no differences in serum cobalt or chromium levels were identified with this design of a modular dual mobility bearing when compared to a standard polyethylene bearing. Further follow-up will be necessary to determine if this finding is consistent over time.

Paper 146

The Effect of Surgical Staff Intraoperative Turnover on Operative Times and Complication Rates for Elective Primary Arthroplasty

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PURPOSE: To evaluate the effect of intraoperative surgical staff turnover on operative times and complication rates for primary joint arthroplasty (TJA).

SIGNIFICANCE: Non-orthopedic literature has demonstrated an association between surgical staff turnover and increased operative times, however, the effect of intraoperative staff turnover in TJA is poorly understood.

METHODS: Operative timepoints, surgical staff, postoperative complications, and length of stay (LOS) were collected from medical records for 2,216 primary TJAs. Univariate analysis was performed to evaluate effect of intraoperative surgical staff turnover on operative times and complication rates.

RESULTS: Intraoperative scrub turnover occurred in 51.4% of cases and correlated with significantly longer operating (134.9 vs. 126.6 minutes, $p < 0.0001$), total OR (164.9 vs. 155.8 minutes, $p < 0.0001$), and TSC times (206.2 vs. 200.2 minutes, $p = 0.0115$). There were similar complication rates (2.7% vs. 2.0%, $p = 0.2974$).

Intraoperative circulator turnover occurred in 20.4% of cases and correlated with significantly longer operating time (139.1 vs. 128.7 minutes; $p < 0.0001$), total OR time (170.2 vs. 157.9 minutes, $p < 0.0001$), TSC time (214.3 vs. 200.1 minutes; $P < 0.0001$), and LOS (2.04 vs. 1.76 days; $p < 0.0016$). There were similar complication rates (2.2% vs. 2.4%, $P = 0.7736$).

CONCLUSION: Minimizing surgical staff turnover may lead to increased OR efficiency and shorter LOS in primary TJA.

Paper 147

Comparison of Postoperative Instability and Acetabular Cup Positioning in Robotic-Assisted vs. Traditional Total Hip Arthroplasty

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PURPOSE: Robotic-assisted total hip arthroplasty (R-THA) has become more prevalent over the last decade and its precision has yet to be conclusively translated into clinical benefits. The primary purpose of this study is to compare dislocation rates and related revisions between R-THA and manual total hip arthroplasty (M-THA). Secondly, the study investigated acetabular cup position, available postoperative patient reported outcome measures (PROMs), and 90-day postoperative complications.

METHODS: A three-surgeon retrospective cohort study was conducted on 2,247 consecutive patients (1724 M-THA, 523 R-THA) who received a primary THA between January 2014 and June 2020 at a single suburban academic hospital. Patient demographics, PROMs, postoperative ED visits, readmissions, and 90-day complications were collected via the Michigan Arthroplasty Registry Collaborative Quality Initiative. Individual chart review yielded dislocation rates with average follow-up of four years. Multivariate regression analysis was performed for primary and secondary outcomes. A representative sample of 386 radiographs including all dislocations were assessed for cup position.

RESULTS: There were significantly lower rates of postoperative dislocation in R-THA (0.6%) vs. M-THA (2.5%; OR, 3.74; $p < 0.046$). All robotic dislocators were successful with conservative treatment, whereas 46% of traditional dislocators were revised for recurrent instability. Cup anteversion ($25.6 \pm 5.4^\circ$ R-THA vs. $20.6 \pm 7.6^\circ$ M-THA) was significantly greater and cup inclination ($42.5 \pm 5.3^\circ$ R-THA vs. $47.0 \pm 6.7^\circ$ M-THA) was significantly lower in the R-THA group ($p < 0.05$). No significant differences were noted patient demographics, PROMs, or other complications ($p > 0.05$).

CONCLUSIONS: R-THA resulted in less than one fourth the dislocation rate compared to M-THA and no revision for instability. It was associated with no difference in PROMs or other early complications. The influence of R-THA on instability goes beyond simply cup positioning and deserves further study.

Paper 148

When Do We Recommend Surgery? Trends and Demographic Associations of Baseline PROMs Before THA

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BACKGROUND: Baseline PROMs influence improvement in pain and function after total hip arthroplasty (THA), which has motivated some payers to incorporate these measures into reimbursement valuation. Increased focus on baseline PROMs demands better understanding of temporal and demographic variability. We aimed to explore 1) baseline PROMs trends over the past 5-years stratified by patient-determinants; 2) patient-factors associated with poor pain and function (25th percentile) preoperatively; and 3) inter-surgeon variability in PROM thresholds for surgical candidates.

METHODS: A prospective cohort of 6,902 primary THAs was enrolled in a single healthcare system (2016-2020). Demographics, comorbidities, surgeon details, and PROMs were collected preoperatively. Outcomes included quarterly trends (5 years; 20 quarters) in HOOS-pain, and HOOS-PS (i.e., function), stratified by sex and race as well as baseline HOOS-pain/PS values of the whole 5-year cohort regardless of temporal trends. Multivariable regression assessed temporal variation and associations with patient-determinants.

RESULTS: Overall mean HOOS-pain and HOOS-PS were 35.2 (± 16.7) and 49.8 (± 19.9). Baseline HOOS-pain exhibited equivalent means across quartiles ($p = 0.166$). Baseline HOOS-PS demonstrated progressively improving function over time (2016- Q1: mean = 47.3; 2020-Q4: mean = 53.0; $p = 0.015$). Such trends were appreciable in males, females, and White ($p < 0.001$, each) but not Black patients ($p = 0.67$). There was significant inter-surgeon preoperative PROMs variation in HOOS-pain and-PS ($p < 0.001$). Higher odds (OR) of low baseline HOOS-Pain and-PS were detected among females (OR = 1.75, 95% confidence interval (CI) [1.55-1.98]; $p = 0.017$, and OR: 1.56, 95% CI [1.38-1.77]; $p = 0.021$), Blacks (OR: 1.64, 95% CI [1.35-2.82]; $p < 0.001$ and OR: 1.59, 95% CI [1.34-1.89]; $p < 0.001$), smokers (OR: 1.56, 95% CI [1.29-1.89]; $p < 0.001$ and OR: 1.52, 95% CI [1.25-1.85]), respectively, and Medicare/Medicaid insurance recipients (OR: 1.34, 95% CI [1.16-1.55]; $p < 0.001$ for HOOS-pain only).

CONCLUSION: Patients are receiving THA at lower preoperative function than five years ago. However, this was not evident among Black patients who have been at a consistent relatively low level of function. Variable patient- and surgeon-determinants may influence pain/functional impairment levels prompting surgery. Payers and policymakers should account for evolution of baseline PROMs in value-based compensation and ensure equitable THA access.

Paper 149

Changing Surgical Approach From Primary To Revision THA Is Not Associated With Increased Risk Of Dislocation or Re-revisions

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INTRODUCTION: Many considerations dictate preferred surgical approach in revision total hip arthroplasty (THA). No prior studies have examined outcomes based on utilizing a concordant vs. discordant approach between the primary and revision THA. This study aimed to quantify approach concordance/discordance from primary to revision THA, and assess impact on incidence of dislocation, re-revision, reoperation, and nonoperative complications.

METHODS: Between 2000–2018, 790 revision THAs were retrospectively identified in patients who underwent primary THA at the same academic center. Patients with primary THA performed for oncologic resection or using uncommon approaches were excluded. Surgical approach was determined for primary and revision THA with dislocations, re-revisions, reoperations, and complications determined from our total joint registry. Complication rates were compared between those with concordant and discordant surgical approaches. Mean age was 61 years, 51% were female, mean BMI was 31 kg/m², and mean follow-up was 4 years.

RESULTS: Surgical approach discordance occurred in 106 cases (13%), which was more frequent (71%, $p < 0.001$) when the direct anterior approach was used for primary THA compared to lateral (12%) or posterior (10%) approaches. There were no statistically significant differences in the incidence of dislocations, re-revisions, reoperations, and nonoperative complications among those with concordant and discordant approaches for the overall cohort and when analyzed by primary approach ($p > 0.13$ for all). Among patients with a posterior approach during primary THA, there was a trend toward decreased dislocation risk with a revision lateral approach compared to posterior approach (5-year rate: 8% vs. 16%, respectively; $p = 0.24$).

CONCLUSION: Comparable dislocation and complication rates were observed among revision THAs with concordant and discordant approaches between primary and revision THA. These data provide reassurance that changing vs. maintaining the surgical approach from primary to revision THA does not significantly increase dislocation risk or that of re-revision, reoperations, and nonoperative complications.

SUMMARY: Comparable complication rates were observed in revision THAs with concordant and discordant approaches between primary and revision THA, providing reassurance to approach per surgeon preference.

Paper 150

Compressive Force Achieved and Maintained by Different Design Cerclage Cables

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INTRODUCTION: Cerclage cables are frequently used to apply compression across the bone-implant interface, but there is little data regarding the force maintained by the cerclage cables after the tensioning device is removed.

METHODS: Three different designs of cobalt-chrome alloy cerclage cables were compared, including two beaded and one non-beaded cable design. Each cable was tensioned with the appropriate device around a hydraulic dynamometer to a predetermined target of 190 pounds, as measured via the dynamometer. The tensioning device was kept in place to maintain the compression of the cable near the target force while the cable was crimped. Measurements were taken (1) with the tensioning device in place, (2) directly after compression was applied across the crimp, but prior to removal of the tensioning device, and (3) finally after the tensioner was removed and the excess cerclage cable was trimmed. The forces measured at the second and third stages were used to calculate the percentage of the initial compressive force lost in the process of crimping and trimming the cerclage cables. Nonparametric analyses were used to assess for differences in the force lost between cable types.

RESULTS: The forces measured for the three cable types at each of the three time-points were as follows—1.6 mm beaded cable: 193 lbs, 163 lbs (16% loss), 155 lbs (20% loss); 1.6 mm nonbeaded cable: 188 lbs, 175 lbs (7% loss), 170 lbs (10% loss); 1.7 mm beaded cable: 190 lbs, 129 lbs (32% loss), 129 lbs (32% loss) ($p > .05$).

CONCLUSIONS: All cables tested showed a substantial loss of compressive force incurred during the crimping process. The non-beaded cable with the two-sided tensioner demonstrated a trend towards greater force retention, although this was not significant with the numbers available.

Paper 151

Collarless Taper-Slip and Collared Composite Beam Stems Differ in Failure Modes and Reoperation Rates

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INTRODUCTION: Cemented femoral components have been advocated for use in older patients based on lower risk of periprosthetic fracture and implant loosening. There are two main categories of cemented stems: collared composite beam (CB) and collarless taper-slip (CTS). This study reports survivorship free of periprosthetic femoral fracture, revision, and reoperation when comparing femoral designs.

METHODS: We retrospectively studied 1,306 primary hybrid THAs with highly cross-linked polyethylene liners for osteoarthritis between 2000 and 2018. During the same period, 17,086 uncemented stems were implanted. There were 798 EON CB and 508 Exeter CTS stems. Choice of stem was at surgeon discretion. Mean age 77 years, 70% female, and mean BMI was 29 kg/m². An inverse treated probability weighted (ITPW) model was utilized to control for fracture risk factors including age, sex, BMI, surgical year, and surgeon.

RESULTS: Combining intraoperative and postoperative fractures, there was no difference in incidence of periprosthetic fracture at 10 years (CTS 9% vs. CB 5%; HR 1.4; p = 0.47). There was an increased risk of intraoperative fractures requiring fixation in the CB cohort (7/798 (5 calcar, 2 GT) vs. 0/508, p<0.001). There was an increased risk of postoperative Vancouver B2 fractures in the CTS cohort (7/508 vs. 0/798; p<0.001). Conversely, there was a higher risk of femoral loosening in the CB cohort (3/798 vs. 0/508; p<0.0001). These combined modes of failure led to a higher survivorship free of revision (98% vs. 91%; HR 4; p = 0.001) and free of reoperation (96% vs. 88%; HR 2.5, p = 0.002) in the CB cohort.

CONCLUSION: The risk of periprosthetic fracture requiring implant revision was increased in the CTS cohort, largely driven by Vancouver B2 fractures. The increased risk of this particular fracture should be weighed against an increased risk of femoral loosening and intraoperative fracture in the CB cohort.

Paper 152

Safety of Total Hip Arthroplasty in a Free-Standing Ambulatory Surgery Center in Medicare Age Patients

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INTRODUCTION: With recent Medicare approval of outpatient THA in the free-standing ambulatory surgery center (ASC), this study sought to evaluate the safety of outpatient THA with planned same-day discharge (SDD) in a Medicare-aged population.

METHODS: A retrospective review of patients undergoing primary THA in two free-standing ASCs from January 2014 to June 2020 was performed. Patients 65 and older were evaluated for preoperative and demographic variables, day-of-surgery and intraoperative variables, and postoperative complications. Facility duration, time to postoperative ambulation, and postoperative facility duration were recorded. A Shapiro-Wilk test was used to evaluate the normality of day-of-surgery times, and they were not normally distributed ($p < 0.001$ for each), thus median duration with interquartile range (IQR) was used. Postoperative evaluation included reoperations, readmissions, and emergency visits during the 90-day global period.

RESULTS: Seventy-one patients were included. Average age and BMI were 67.8 ± 2.7 years and 29.9 ± 5.8 , respectively. Patients had 2.1 ± 1.4 medical comorbidities, with hypertension being most common (39, 54%). Twenty-three (32%) patients were current or former smokers. One patient was ASA Class 1, 52 were ASA Class 2, and 18 were ASA Class 3. Total facility duration was 8 hours and 45 minutes (8:45) (IQR 7:15, 10:10). Postoperative time to ambulation was 3:30 (IQR 2:42, 4:35), and postoperative facility duration was 4:50 (IQR 3:53, 6:35). Sixty-eight patients (96%) underwent SDD, 2 had next-day discharge (NDD), and 1 necessitated hospital transfer. One intraoperative complication of excessive blood loss was noted, and 2 patients required an indwelling Foley catheter at discharge. Fifteen patients (21%) had postoperative nausea, which was controlled with medications prior to discharge. No patients required reoperation or readmission, and one patient had an ED visit for NSAID-related gastric complaints.

CONCLUSION: Appropriately selected Medicare-age patients can undergo outpatient THA at a free-standing ASC with reliable SDD and acceptable complication profiles.

Paper 153

Are There Differences in Conversion Total Hip Arthroplasty Following Failure of Previous Intertrochanteric Fracture Treated with Extra-medullary vs Intra-medullary Devices? A Systematic Review from 2010-2020

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INTRODUCTION: Intertrochanteric fracture (ITFx) fixation is frequently done using either extramedullary (DHS) or intramedullary devices (IM nail). When fixation fails conversion total hip arthroplasty (cTHA) may be necessary. We aimed to evaluate the differences in the clinical outcomes for patients undergoing cTHAs following previous ITFx fixation with extramedullary vs intramedullary devices.

METHODS: Using the PRISMA guidelines for systematic analysis, we performed a query of the English language literature from 2010-2020 in PubMed, Google Scholar, and Web of Science databases. We included case series with a minimum follow-up of 24 months.

RESULTS: Nine studies met the inclusion criteria. The final analysis included 837 patients in the extramedullary group (Group 1), and 474 patients in the intramedullary group (Group 2). Group 1 patients were older than the Group 2 patients (67 vs. 66 years, $p = 0.001$). Group 1 patients had longer mean follow-up than Group 2 patients (40 vs. 38 months, $p < 0.001$). Fixation failure was more likely to occur in Group 1 than in Group 2 (56% vs. 28%, OR = 3.3, 95% CI: 2.2 to 4.9, $p < 0.001$). However, group 1 patients had lower rates of nonunion (16% vs. 40%, $p < 0.001$), and femoral head osteonecrosis (7% vs. 16%, $p = 0.002$). Overall complications after cTHA were no different between the two groups (20% vs. 22%, $p = 0.31$). After cTHA, there were no differences between the two groups in the rates of periprosthetic fracture (6% vs. 6%, OR = 1.09, 95% CI = 0.7-1.8, $p = 0.72$), infection (1.9% vs. 1.5%, $p = 0.65$), or dislocation (3.0% vs. 3.7%, $p = 0.22$). Medical complications were lower in Group 1 patients (5.0% vs. 8.3%, $p = 0.03$). The rate of reoperation was similar between the two groups (3.5% vs. 3.9%, $p = 0.75$).

CONCLUSION: Our data using meta-analysis of the most recent (past 10 years) publications showed comparable outcomes after cTHA between both groups contradicting older studies that indicated poorer outcomes with intramedullary devices.

Paper 155

Predictors of Re-Operation in Adolescents Undergoing Hip Preservation Surgery for Femoroacetabular Impingement

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BACKGROUND: Femoroacetabular Impingement (FAI) is a condition caused by repetitive motion of abnormal hip osseous anatomy that contributes to labral and chondral injury. An understanding of radiographic parameters associated with successful primary surgery has not been well established.

HYPOTHESIS/PURPOSE: The primary objective was to determine preoperative radiographic parameters that predict reoperation for FAI and, secondarily, correlate radiographic measures and outcomes in these patients.

METHODS: A prospectively-collected institutional registry of adolescent patients (age <19 y.o.) who underwent surgery for FAI (arthroscopic/open) was reviewed. Standing AP pelvis X-rays were analyzed for alpha, lateral center edge (LCEA), Tönnis, and Sharp's angles, and femoro-epiphyseal acetabular (FEAR) index. Patient-reported outcomes (PROs) [modified Harris Hip Score (mHHS), Hip Disability and Osteoarthritis Outcome Score (HOOS)] were analyzed. Mann-Whitney-U test was used to compare the radiographic measures of re-operation to non-reoperation patients and those who achieved MCID to those who did not. Radiographic indication of risk for re-operation was evaluated with receiver operating characteristic (ROC) analysis. Spearman's correlation was calculated between radiographic measurements and PROs at two-years postop.

RESULTS: Eighty-seven patients underwent primary surgery (56 surgical dislocations vs. 31 scopes) for FAI. The average age at time of primary operation was 16.27 years (73.6% Female). 10 underwent re-operation (11.5%) at an average of 20.6 months from primary surgery. No differences were found in demographics, activity, surgery type, labral disease, or alpha angle for re-operation vs. non-reoperation. The LCEA, FEAR index, Sharps, and Tönnis angle were significantly different ($p < 0.05$). ROC analysis indicated that $LCEA < 21^\circ$ and $FEAR \text{ index} > -8.8$ were predictors for increased risk of reoperation. Patients with $LCEA < 21^\circ$, 46% underwent a reoperation compared to those with $LCEA > 21^\circ$ (6%). Patients with $FEAR \text{ index} < -8.8$, 32% underwent a reoperation compared to patients > -8.8 (5%).

Patients who achieved MCID (61.9%) had lower BMI, worse preoperative PROs, and better postoperative PROs at two-years. Alpha, Tönnis, and Sharp's angles were positively correlated with 2+ year PROs, while LCEA was negatively correlated ($p < 0.05$).

CONCLUSION: In patients undergoing treatment for FAI, a reoperation was associated with radiographic signs of hip dysplasia, indicating that patients with a shallower acetabulum are at risk for a repeat operation. Surgeons can utilize these parameters to help in surgical decision making, better predict outcomes, and to counsel patients the need for potential subsequent surgery.

Paper 156

Risk Factors For Nonunion In Pediatric Lateral Column Lengthening Surgery

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INTRODUCTION: The Evans/Mosca procedure remains the most utilized extra-articular osteotomies for correction of pes planus. Lengthening is created by inserting a graft in the anterior aspect of the calcaneus through a complete transverse osteotomy. Failure of conservative methods, particularly for rigid pes planus, is a primary consideration for surgical management. Complications include delayed union, nonunion, malunion, subluxation of the calcaneocuboid joint, and persistent lateral column pain. Our study analyzes risk factors for the development of nonunion.

METHODS: After IRB approval, 157 cases (120 patients) were analyzed for incidence of nonunion defined by clinical and radiographic evidence of absence of union >6 months. Delayed union was diagnosed if healing without a complete union at >6 months. Exclusions: age >18 and revision lateral column lengthening. Patients' medical records were reviewed for demographics, complications, and surgical techniques.

RESULTS: The cohort consisted of 75 females (47.8%) and 82 males (52.2%). The median age was 12 with an interquartile range (IQR) of 3. 6 patients (3.7%) had wound complications or nerve injury. Nonunion occurred in 7 of 157 cases (4.5%) with 2 of 157 cases (1.3%) experiencing delayed union. The median age of nonunion was significantly higher than union (13.2 (IQR 2.75) vs. 11.2 (IQR 3) respectively). The fixation construct used was associated with an increased risk of nonunion. Patients with screw fixation had the highest rate of nonunion at 50% (2/2) compared to pin and/or staple fixation at 6.8% (5/73), no fixation at 4% (3/75), and plate fixation at 0% (0/2). Delayed union patients were treated with ultrasound bone stimulation and were able to achieve complete union. Revision was attempted in 5/7 nonunions with all operative patients achieving union.

CONCLUSION: Our study analyzed risk factors for nonunions in patients undergoing calcaneal lengthening osteotomy for pediatric pes planus. We found age at time of surgery and graft fixation method to be significant risk factors for the development of nonunion. Our study highlighted, patients who had nonunion were on average >2yrs older. Overall, lateral column lengthening is a well-tolerated procedure with a complication rate, including non- and delayed union, of 10.8%. Surgeons should be aware, in the largest cohort of pediatric Evans/Mosca procedures to date, patient age and type of fixation were associated with nonunion.

Paper 157

Elective Musculoskeletal Surgery Leads to Postoperative Weight Changes in Pediatric Patients

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BACKGROUND: Patients who undergo orthopedic surgeries often have reduced activity levels during postoperative recovery. Little is known about whether these extended periods of activity restriction lead to weight changes in pediatric patients. The purpose of this study was to evaluate changes in body mass index (BMI) percentile in pediatric patients over 2.5 years following primary musculoskeletal surgeries.

METHODS: After IRB approval was obtained, institutional records for utilized current procedural terminology (CPT) codes were used to identify patients 21 years of age or younger who underwent elective surgery at a single tertiary care pediatric orthopedic institution between October 2016 and December 2018. Non-primary surgeries and patients without preoperative BMI measurements were excluded. Demographic characteristics, height, weight, and BMI at every postoperative follow-up visit within 30 months of surgery (if available) were collected. To account for expected growth with increased age, BMI percentiles relative to age were calculated. Statistical analysis of changes in BMI percentile at postoperative follow-up intervals of 3-7 months, 9-18 months, and 24-30 months after surgery was performed for the overall sample, within procedure categories, and within preoperative weight categories.

RESULTS: 1,566 patients (53.1% female, average age 12.4 years [5-20]) were available for study. Over one-third of patients were overweight or obese at presentation. Overall, the average change in BMI percentile relative to baseline was increased at all three follow-up intervals, with values reaching significance at 9-18 months (2.55 percentile points, $p = .002$) and 24-30 months (5.47 points, $p = .001$). However, comparisons across preoperative BMI categories revealed that while underweight or normal-weight patients were likely to have significantly increased BMI percentile at all three timepoints, overweight or obese patients tended to decrease BMI percentile. Patients undergoing spine surgery demonstrated the same pattern, with particularly large increases in BMI percentile among underweight spine patients and decreases among overweight and obese spine patients. Overall, the proportion of patients who were overweight or obese had grown by the end of the study.

CONCLUSION: Children and adolescents undergoing elective orthopedic surgery display a tendency to increase BMI percentile postoperatively. However, patients at the extremes of weight may experience improvement toward the mean. These findings can be used to counsel patients and families on expectations after surgery.

Paper 158

Pediatric Orthopaedic Trauma: What Defines "Pediatric?"

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INTRODUCTION: Trauma is the leading cause of morbidity and mortality in children. Better outcomes have been demonstrated in pediatric trauma patients who receive care at pediatric trauma centers compared to community hospitals or adult trauma centers. This highlights the importance of understanding the unique physiologic characteristics of pediatric patients and suggests that pediatric orthopedic trauma may be best defined physiologically, by physeal closure, rather than age. This study seeks to determine how leading pediatric orthopedic departments in the United States define pediatric trauma patients and how these institutions manage skeletally mature adolescent trauma patients.

METHODS: A 19-question survey was sent to one designated Pediatric Orthopedic Society of North America (POSNA) member at each of the Top 50 Children's Hospitals for Orthopedics as ranked by U.S. News and World Report in 2019. Questions utilized multiple choice, yes/no, and open-ended response formats to obtain information about how pediatric orthopedic trauma patients are managed.

RESULTS: Forty-eight of the 50 surveys (96%) were completed. Pediatric orthopedic trauma is defined by patient age at 78% of respondents' institutions. The mean upper-age limit was 18 years, with a range of 14-26 years. The remaining 22% of institutions define pediatric orthopedic patients as those with open physes. All but 3 of the institutions identified as level 1 or level 2 trauma centers. All institutions reported treating simple and complex fractures in skeletally immature patients. Long bone fractures in skeletally mature patients were treated by 96% of pediatric orthopedists. Complex periarticular fractures in skeletally mature patients were treated by 67% of respondents, as were 25% of operative pelvic and acetabular fractures in skeletally mature patients. At over 75% of institutions in which complex fractures in skeletally mature patients were not treated by pediatric orthopedists, an affiliated adult orthopedist came to the pediatric institution to provide care.

DISCUSSION: Nearly 80% of the leading pediatric orthopedic hospitals in the United States define pediatric trauma patients based on age. Most pediatric orthopedists manage complex periarticular and long bone fractures in skeletally mature adolescent patients. Increases in the national volume of pediatric orthopedic trauma and rates of pediatric orthopedist referrals exacerbate the growing concern for a potential shortage of fellowship-trained pediatric orthopedists. We challenge the norm of defining pediatric orthopedic trauma patients based on an age cutoff. Defining pediatric orthopedic patients based on physeal closure may facilitate improved outcomes while helping to offload the burden of patient volume facing pediatric orthopedists.

Paper 159

Pediatric Ballistic Epidemiology: Two Year of Pediatric Orthopaedic Consults at a Level I Trauma Center

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INTRODUCTION: Gun violence endures as a preventable cause of morbidity and mortality in the United States. The prevalence of gunshot wound (GSW) related injury to children is notable; but minimal data exist concerning the epidemiology, injury types, and outcomes of ballistic injuries in pediatrics. Our study aims to: (1) determine the prevalence of pediatric ballistic trauma at a major level I trauma center, (2) characterize the etiology of GSW and resulting orthopedic injury, and (3) identify rates of concurrent vascular, nervous, and infectious complications.

METHODS: Patients under age 18 who presented to a single level 1 pediatric trauma center for management of ballistic trauma between May 2018 and June 2020 were compiled from a retrospective database of orthopedic consultations. Chart review was performed to compile clinical information. Patient demographics, fracture characteristics, antibiotic timing and administration, additional injuries and injury management, complications, follow-up, and the circumstances surrounding the GSW were recorded. We stratified GSW causes as intentional (including bystander) vs. accidental and self-inflicted vs. other-inflicted. Patients were classified as either children or adolescents if they were below or above 10 years old respectively. T-tests, Chi-squared, and Fisher's exact tests evaluated statistical significance ($\alpha = 0.05$).

RESULTS: Seventy-two patients were identified, including 62 males and 10 females. Mean age was 15.6 years (SD 3, range 2.4-17.9 years). Six patients were children; 66 were adolescents. The majority, (62/72, 86.1%) were shot in an intentional gun violence event. Only three shootings were self-inflicted. Children were statistically more likely to be victims of an accidental shooting or sustain a self-inflicted GSW than adolescents. Sixty-two patients (86.1%) had a fracture secondary to the gunshot, with no difference in rates of concomitant fracture, visceral, nerve, vascular injury, and infections by age group or sex. Twenty-eight of 72 (38.9%) underwent surgery by the orthopedic service. Four patients (5.6%) developed an orthopedic infection. One child developed growth arrest secondary to disruption of the physal plate.

CONCLUSION: This descriptive study of pediatric ballistic injuries provides valuable information regarding GSW injuries and potential avenues of care for these patients. Pediatric ballistic injuries frequently lead to injury requiring operative intervention. Moreover, the prevalence of violent injury in this urban population is higher than previously reported, indicating that our pediatric population is at a higher risk of morbidity secondary to ballistic violence than the national average.

Paper 160

Screw Thread Configuration Has No Effect on Outcomes of In Situ Fixation for Stable Slipped Capital Femoral Epiphysis

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INTRODUCTION: The treatment for SCFE is largely operative to provide stabilization for the epiphysis, prevent slip progression, and avoid complications such as avascular necrosis (AVN). The current "gold standard" treatment is insertion of a single cannulated screw down the center of the epiphysis. There is still debate as to the optimal thread configuration of the screws. Biomechanical models suggest no clinically significant difference in the use of single-screw fixation stability between partially- (PTCS) and fully-threaded (FTCS) cannulated screws. The primary purpose of the present study is to compare such constructs in a clinical model.

METHODS: 152 patients undergoing cannulated, stainless steel, in situ screw fixation of SCFE between January 2005 and April 2018 were included. Procedure laterality, screw number and thread configuration (partially-/fully-threaded), bilateral diagnosis, Loder classification, final follow-up, patient demographics, and endocrinopathy history were analyzed. Primary outcomes were return to the operating room (ROR), AVN, hardware failure/removal, and femoroacetabular impingement (FAI).

RESULTS: Most patients received a single (86.2%), partially-threaded (81.6%) screw; most were unilateral (67.8%) and stable (79.6%). Mean follow-up was 2.0 ± 2.7 y, with a 15.8% rate of ROR, 5.3% exhibiting AVN, 6.6% exhibiting FAI, and 9.2% experiencing hardware failure/removal. Number of screws was the sole predictor of ROR (Odds ratio [OR]: 3.35, 95% CI: 1.18-9.49). Unstable SCFE increased the odds of AVN (OR=38.44; 95% CI: 4.35-339.50) as did older age (OR=1.43, 95% CI: 1.01-2.03). Female sex increased risk for FAI (OR=4.87, 95% CI: 1.20-19.70), and bilateral SCFE elevated risk for hardware failure/removal versus unilateral SCFE (OR=4.41, 95% CI: 1.39-14.00). Screw thread configuration had no significant effect on any outcome (for each, $P \geq 0.159$).

DISCUSSION & CONCLUSION: Rates of ROR, AVN, FAI, and hardware failure/removal did not differ between patients treated with partially- or fully-threaded screws. Use of 2 screws was associated with increased likelihood of ROR. The primary limitation of the study is that of utilizing and relying upon a retrospective convenience sample. In summary, these findings suggest that screw thread configuration has no impact on complication rates, whereas screw number may be an important consideration in SCFE fixation.

Paper 161

Time to Return to School Following ACL Reconstruction

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INTRODUCTION: In recent years, the incidence of anterior cruciate ligament (ACL) injury, and therefore ACL reconstruction, has been increasing in school-aged patients. Due to complications of delayed ACL reconstruction, students are often forced to miss extended periods of school. Return to school data has been underreported in the literature, and no study has examined return to school data in the age of COVID-19, where many school districts have virtual distance learning options. The purpose of this study is to determine how many days of school school-aged patients should expect to miss following ACL reconstruction and how the availability of remote learning during the COVID-19 pandemic affected this.

METHODS: A prospective cohort of 53 ACL reconstruction patients in grades 7-12 undergoing surgery during the school year was identified. Medical records were reviewed, and patients were surveyed on the day of surgery and two weeks postop. Pre-COVID and post-COVID patients were compared as most post-COVID patients were offered a virtual distance learning option to return to school. Mean BMI was 25 kg/m², 55% of patients were male, and mean age was 16 years. T-tests were used to compare outcomes between groups.

RESULTS: Overall, patients missed an average of 4.4 (SD, 3.0) days of school after ACL reconstruction surgery. Patients in the pre-COVID group missed an average of 5.5 (SD, 2.9) school days, while patients in the post-COVID group missed an average of 2.3 (SD, 1.4) school days ($p = .003$). Eighty-nine percent of post-COVID patients first returned to school utilizing a virtual option. Among those returning virtually, these patients missed an average of 1.9 (SD, 0.9) school days.

CONCLUSIONS: A virtual distance learning option results in fewer missed days of school post ACL reconstruction. When given this option, school-aged patients can expect to return to school within two days postop. Otherwise, patients should expect to miss about one week of in-person schooling. In this regard, the COVID-19 pandemic has positively impacted education for students post surgery, and physicians should advocate for continuing virtual options for students receiving medical treatment.

SUMMARY: In a cohort of 53 school-aged ACL reconstruction patients, students missed an average of 4.4 days of school following surgery. Students undergoing surgery post-COVID returned to school earlier, after missing only 2.3 school days on average due to a virtual distance learning option.

Paper 162

Estimating Skeletal Maturity by Segmented Linear Modeling of Key AP Knee Radiographic Parameters

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BACKGROUND: The recently described Modified Fels knee system allows for accurate skeletal maturity estimation using an AP knee radiograph, but requires seven parameters. A faster method may have clinical utility in the outpatient setting.

METHODS: Seven AP knee radiographic parameters associated with 90% of final height (an enhanced skeletal maturity standard compared to peak height velocity) were analyzed in 78 children. Segmented linear regression and generalized estimating equation (GEE) analyses were used to identify the most important parameters for each patient based on different initial criteria (age, sex, FemK parameter score). Ordinary least squares regression analysis was used to identify appropriate breakpoints for segmented regression based on age. The accuracy of the resulting skeletal maturity estimation models was evaluated and compared with the full Modified Fels knee system and with the Greulich and Pyle (GP) left hand bone age.

RESULTS: 326 left knee radiographs from 41 girls (range, 7 to 15 years) and 37 boys (range, 9 to 17 years) were included. Models generated by segmented regression and GEE analysis required fewer parameters (range, 1 to 5 parameters) than the full Modified Fels knee system (7 parameters). Skeletal age estimates produced by segmented regression models (range, 0.37 to 0.39 year mean discrepancy from actual skeletal age) were more accurate than GP ($p < 0.05$) and not significantly different from the full Modified Fels system ($p > 0.05$). The percentage of outlier estimations (estimations > 1 year off from actual years from 90% final height) made by segmented regression models was not significantly different from GP ($p > 0.05$) or the Modified Fels knee system ($p > 0.05$).

CONCLUSIONS: An abbreviated version of the Modified Fels knee system can estimate skeletal maturity more accurately than the Greulich and Pyle system with just two to three radiographic knee parameters. This abbreviated system may allow for rapid skeletal age estimation (~30 seconds) appropriate for routine outpatient practice. We continue to recommend the full Modified Fels knee system when making a final surgical determination.

Paper 163

Femoral and Tibial Indications for Initial and Reoperation Surgeries with Fassier-Duval Intramedullary Rods for Children with Osteogenesis Imperfecta

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Osteogenesis imperfecta (OI) is a genetic connective tissue disorder affecting quantity and integrity of collagen type I, which is integral for the strength of osseous tissue. OI has a heterogeneous molecular inheritance pattern – divided into four major subgroups (I-IV). Defects in collagen protein products lead to poor development of skeletal structures and increased fracture rates. Children with OI suffer from multiple fractures and bone deformities often requiring surgical intervention with osteotomies and intramedullary telescoping rods, chiefly with Fassier-Duval (FD) rods. Our study examined the relationship between initial and reoperation indications for femur and tibia FD rodding surgeries based on age, bone, and OI type.

Retrospective chart review of initial surgeries included 197 bones (femurs and tibias) from 58 patients. Reoperations included 140 bones from 45 patients. Variables included age at first operation (0-24, 24.1-48, 48.1+ months), time to reoperation, operation indications, bone, and OI type. Spearman correlations were used separately for each bone-type to assess associations between age at first surgery and total number of surgeries. To assess dichotomous outcomes generalized estimating equations were utilized and adjusted for bone-type and side. Hazard ratios and associated 95% confidence intervals were derived from frailty survival models for the time to first reoperation outcome. Kaplan-Meier curves were generated to display time to reoperation, stratified by age at first operation and bone-type. Data was collected from 2003-2018. Analyses were performed using SAS software v9.4.

There was a statistically significant correlation between age at first surgery and indication (bowing and fracture) for initial ($p < 0.0001$, $p = 0.01$) and reoperation surgeries ($p = 0.004$, $p = 0.03$), respectively. All bones, except left tibias, showed significant negative correlation between age at first surgery and total number of surgeries. Both older age at first surgery groups (24.1-48, 48.1+ months) had significantly lower risks of needing reoperation relative to the 0-24 months group ($p = 0.0003$, $p = 0.0004$). Descriptive analyses suggest median survival of FD rods in OI type III was decreased relative to type IV, XV, or unknown when initial surgery was between 0-24 months.

Bowing and fractures are the most common causes for initial and reoperation surgeries in children with OI. Patients in older age groups at first surgery need fewer reoperation surgeries. Median survival probabilities of FD rods increased when age at first surgery was after 48.1+ months. OI type may impact median survival of FD rods.

Paper 164

Calculated Blood Loss Associated with Posterior Spinal Instrumented Fusion in Adolescent Idiopathic and Neuromuscular Scoliosis

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INTRODUCTION: Posterior spinal fusion for scoliosis correction can be associated with substantial blood loss. Allogenic blood transfusion remains an important tool for management of acute perioperative anemia, however, is not without risks. Accurately characterizing risk factors and identifying strategies for minimizing blood loss are thus important for operative planning. Previous literature on the subject utilize estimated blood loss, which may underestimate the degree of bleeding, and are limited in their usage of new anti-fibrinolytic medications and electrocautery technology that help minimize blood loss. The goal of this study was two-fold. First, we aimed to compare blood loss as traditionally estimated and as a calculated value based on patient size and laboratory values. Second, we aimed to identify relationships between type of scoliosis and blood loss in the setting of intraoperative anti-fibrinolytic medication and bipolar electrocautery. We hypothesized that estimated blood loss (EBL) significantly underestimates total blood loss compared to calculated blood loss (CBL), and that patients with neuromuscular scoliosis (NMS) have increased blood loss compared to counterparts with idiopathic scoliosis (AIS).

METHODS: Retrospective review was conducted of prospectively collected data within our pediatric spine database. Children who underwent posterior spinal fusion for correction of scoliosis between June 2013 and January 2021 were included. EBL was determined from the estimated intraoperative blood loss and measured postoperative drain output. CBL was computed as originally described by Foss et al. All values were further normalized based on number of vertebral levels fused and patient weight.

RESULTS: Final cohort included 224 children with AIS and 76 with NMS. EBL significantly underestimated total blood loss in both patient populations ($882.2 \pm 447.1\text{mL}$ vs. $1315.0 \pm 375.1\text{mL}$, $P < 0.001$ in AIS; $1132.9 \pm 562.1\text{mL}$ vs. $1455.2 \pm 482.7\text{mL}$, $P < 0.001$ in NMS). Patients with NMS also had significantly greater CBL than those with AIS ($1455.2 \pm 482.7\text{mL}$ vs. $1215.0 \pm 375.1\text{mL}$, $P < 0.001$). All findings were consistent even when normalized by number of vertebral levels fused and patient weight.

CONCLUSION: EBL significantly underestimates blood loss compared to CBL. Patients with NMS undergoing surgical correction also have significantly greater blood loss than AIS counterparts. Updated cutoffs and guidelines would be valuable for more accurate identification of patients at risk for requiring transfusion and determination of when to type and cross-match blood products prior to posterior spinal fusion for pediatric scoliosis.

Paper 165

Favorable Prognosis for Significant Preoperative Upper Extremity Weakness following Elective Anterior Cervical Discectomy and Fusion

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While preoperative weakness is often used as an indication for early surgical intervention, few studies have examined the prognosis for upper extremity motor deficit following ACDF. Therefore, a better understanding of the prognosis for significant preoperative weakness following elective ACDF is needed to improve clinical decision-making, refine the process of preoperative patient counseling, and ultimately improve patient care.

METHODS: We performed a retrospective review of all patients undergoing ACDF at one institution between September 2015 and June 2016. Our study inclusion criteria included: any patient over the age of 18 years undergoing one-level or contiguous two-, three-, or four-level ACDF for the treatment of degenerative cervical disease.

Patients were divided into a group exhibiting significant preoperative weakness (Medical Research Council motor grade less than 4) and a group without significant weakness. Data regarding affected muscle groups and significant improvement postoperatively (to a motor grade 4 or greater) was recorded. Analysis of variance (ANOVA) was used to compare continuous variables between groups. $P < 0.05$ was considered statistically significant for all tests.

RESULTS: Of the 618 patients included in this cohort, 4.3% of patients demonstrated significant preoperative upper extremity weakness (motor grade less than 4). Of these patients with significant weakness, 57.1% of them had more than one muscle group affected. Triceps were the most commonly affected muscle group (26.9%) followed by hand intrinsics (23.1%), finger flexors (20.5%), deltoids (15.4%), and biceps (14.1%). Postoperatively, over 70% of patients experienced an improvement in muscle strength (to a motor grade of 4 or greater) with only 1.1% of patients experiencing significant weakness (motor grade less than 4) at final follow-up. Despite being the most commonly weak muscle group preoperatively, triceps most frequently showed improvement (95.2%) followed by finger flexors (87.5%), hand intrinsics (83.3%), and biceps (63.6%). Deltoids were much less likely to show improvement following surgery (8.3%). In a univariate analysis, myelomalacia on imaging (OR 28.9, $p < .01$) and greater than 2 level fusion (OR 10.1, $p < .01$) were found to be predictive of a failure to improve neurologically.

CONCLUSIONS: Over 70% of patients with significant preoperative weakness undergoing ACDF should expect marked strength improvement postoperatively. Patients with triceps weakness should expect a much more favorable prognosis while those with deltoid weakness should be more guarded. Similarly, patients with myelomalacia should be cautioned that they are at greater risk for not improving.

Paper 166

Early Emergency Department Visits are a Predictor of Increased Healthcare Utilization Within One Year after Elective Spine Surgery

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INTRODUCTION: Emergency department (ED) visits after major surgical procedures are a significant, yet often unconsidered, contributor to healthcare utilization, costs, and fragmentation of patient care. The early use of the ED may, in addition, be a predictor for further health resource utilization after surgery. The aim of this study is to determine the incidence of and risk factors for ED visits in the 90-day period after elective spine surgery and to quantify healthcare utilization in this subpopulation of patients.

METHODS: A total of 623 patients who underwent elective spine surgery between 2013 and 2018 at a single academic institution were identified. Patient and surgical variables were assessed as potential risk factors or predictors of a 90-day postoperative ED visit. Surgical variables included the type of decompression and/or fusion, the spinal region, and the number of vertebral levels. Chi-square and unpaired t-tests were used to compare categorical and continuous variables, respectively, between those with and without a 90-day visit to the ED. Both univariate and multivariate logistic regression was used to estimate risk ratios for these variables of interest. Measures of healthcare utilization were compared between those with and without a 90-day visit to the emergency department following surgery.

RESULTS: 623 patients undergoing decompression and/or arthrodesis procedures were included in the study, of which 51 had a 90-day ED visit (8.2%). Patients with ED visits were more likely to have class II obesity ($p = 0.011$), an American Society of Anesthesiologists (ASA) class of 3 or higher ($p = 0.032$), a higher Charlson Comorbidity Index (CCI) ($p < 0.001$), diabetes ($p = 0.002$), congestive heart failure ($p = 0.013$), and a history of myocardial infarction ($p = 0.044$). The following were predictors of 90-day ED visits: obesity, ASA class 3+, CCI, diabetes, and congestive heart failure. Patients with at least one ED visit within 90-days of surgery had significantly increased healthcare utilization within the 365 days after surgery, including: more CT studies ($p = 0.025$), MR studies ($p = 0.019$), further emergency department visits after 90 days postoperatively ($p = 0.025$), urgent care visits ($p = 0.040$), and cumulative opioid prescriptions ($p = 0.028$).

CONCLUSION: A visit to the ED within 90 days after surgery may be viewed as a surrogate risk factor for further healthcare utilization, warranting intervention by the surgeon and/or health systems to improve coordination of care after elective surgery.

Paper 167

Disc Arthroplasty for Adjacent Segment Disease: a Better Salvage Strategy

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INTRODUCTION: Cervical total disc arthroplasty (TDA) has proven comparable to, or superior to, one and two-level discectomy in patients with cervical herniated disc or degenerative disc disease (DDD). The use of cervical disc arthroplasty has been well studied in primary one and two-level disease, but patients with multilevel DDD or previous fusion were excluded from previous trials, and results in these more challenging patients have not been assessed. Cervical TDA for upper extremity radiculopathy and axial neck pain in patients with preexisting spondylosis and previous surgical treatment was compared to patients with single or two-level primary disease, to determine relative safety and effectiveness of TDA as a salvage strategy for more complex patients.

METHODS: We analyzed 66 consecutive adult patients who underwent one-level or two-level cervical disc arthroplasty for cervical radiculopathy and/or axial neck pain. Two groups were compared: Group 1: Patients meeting original IDE guidelines for inclusion in previous clinical trials, excluding any patient with adjacent level DDD or history of previous cervical fusion, and Group 2: Patients with cervical radiculopathy and/or axial neck pain due to one- or two-level disc herniation or DDD, with history of previous surgery, multilevel spondylosis, adjacent level disease. Patients were treated from 2016 to 2019. Patients were evaluated for perioperative/postoperative complications, and prospectively followed for resolution of neck and arm pain, return to work and activity, and radiographically followed for disc space mobility, or evidence of implant subsidence, loosening, heterotopic ossification, or adjacent segment degeneration.

RESULTS: 51 consecutive patients in Group 1 and 15 in Group 2 were treated for axial neck pain with or without radiculopathy and/or myelopathic symptoms. Mean follow-up was 15 months. No intraoperative or perioperative complications occurred in either group. In Group 1 patients, preoperative VAS for neck pain improved from 7.68 to 1.93, ($p < .001$) in Group 2 patients, preop VAS improved from 7.67 to 2.00, ($p < 0.001$). There was no difference between the two groups with respect to improved neck or arm pain ($p = 0.844$).

CONCLUSION: Cervical disc arthroplasty is a safe and effective alternative to ACDF for axial neck pain as well as cervical radiculopathy in patients with multilevel disease or history of previous fusion. The benefits of CDA in preserving cervical motion and reducing the risk of adjacent segment disc degeneration may be all the more important to patients previously excluded from treatment because of preexisting disease or previous surgery.

Paper 168

Intra-wound Vancomycin Decreases Surgical Site Infection After Spine Surgery: A Retrospective Case-control Study

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BACKGROUND: Surgical site infection (SSI) is a morbid and expensive complication of spine surgery. The use of intra-wound vancomycin has not been sufficiently evaluated. Several studies have shown a decreased rate of SSI with intra-wound vancomycin while others did not have adequate power to detect a difference. This is the first case-control study examining the effect of this SSI prophylaxis. This study aims to define the overall postoperative rate of SSI in patients undergoing spine surgery, to examine the effects of intra-wound Vancomycin on the rate of SSI, and to evaluate the effects of demographics and comorbidities on the development of SSI.

PATIENTS & METHODS: All spine surgeries done at our institution from 2003-2013 were reviewed (n=19,081). All cases of verified SSI (n=316) were included in the cohort with a mean age of 62.6 years \pm 15.7, average BMI of 33.1 kg/m² \pm 8.1, an overall male predominance (n= 186, 58.9%) and average follow up time of 31.5 months. This cohort was matched to controls in a 1:1 fashion based on age, gender, and date of surgery (\pm 30 days). Patients demographics, smoking status, comorbidities, estimated blood loss (EBL), length of surgery, and intra-wound administration of vancomycin were evaluated.

RESULTS: Of the 19,081 spine surgeries performed at our institution, there was a 1.7% rate of SSI. Our conditional logistic regression found that patients who received intrawound vancomycin had significantly lower rates of SSI (OR 0.44, 95% CI 0.23-0.88, p = 0.019). When comparing comorbidities between the SSI cases and the controls, the average BMI in the SSI cases was significantly higher than the controls (p<0.001). Additionally, the OR for developing a surgical site infection with a BMI >30 kg/m² was 1.63 (95% CI 1.04-2.56, p = 0.03). EBL, tumor surgery, operative duration, prior spine surgery, blood transfusion, diabetes, and rheumatoid arthritis were also significant risk factors for SSI.

CONCLUSION: With an overall rate of 1.7%, SSI continues to be a serious but, fortunately, rare complication of spine surgery at our institution. Our data supports the conclusion that in spine surgery intra-wound vancomycin decreases the risk of SSI. Patient risk factors, particularly, obesity, diabetes, and prior spine surgery increase the risk of SSI. These factors should contribute to the preoperative shared decision making done between surgeons and patients. Additional studies on intrawound vancomycin and spine surgery are needed to determine safety, dosing, selection for resistant organisms, and long-term effects on fusion.

Paper 169

Predictor of Survival Length Following Odontoid Fractures

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BACKGROUND: Due to gradual and progressive decline in bone mass, older adults are more susceptible to odontoid fractures following trauma or low-impact falls. Indeed, odontoid fractures are the most common cervical spine fracture in older adults; Type II fractures are considered especially unstable due to high nonunion rates and thus carry the highest risk for complications. Prior work has demonstrated an increased mortality rate associated with this particular fracture. An open question is whether the paradoxically high mortality rate associated with Type II odontoid fractures is a function of the severity of the injury and how it is treated or whether such fractures reflect the culmination of overall health deterioration. The extant literature has focused primarily on (1) whether operative vs. nonoperative management influences survival time, and (2) whether treatment strategy is influenced by patient age and patient comorbidities. Here we examined whether a patient's pre-injury health status directly predicts mortality, independent of spine management factors.

METHODS: A retrospective chart review identified 26 patients (mean age: 80) with confirmed Type II odontoid fractures within our service between 2008 and 2018. Of these, 15 patients received surgical intervention, and the remaining 11 were treated nonoperatively. Patient pre-injury health status was operationalized through the Charlson Comorbidity index. Operative and nonoperative patients were compared using a two-sample t-test. The relationship between pre-injury health status and patient mortality was analyzed using the Pearson correlation coefficient.

RESULTS: Results revealed that age (operative: 81.6, nonoperative 78.7, $t < 1$, n.s.), preinjury health (Charlson Comorbidity index; operative 5.5, nonoperative 4.3, $t = 1.7$, n.s.), and survival length (operative/3.4 years, nonoperative: 2.4 years, $t < 1$, n.s.) did not differ as a function of spine management for the injury. By contrast, a significant relationship between pre-injury health and survival time ($R = -0.55$, $p < 0.05$) was observed.

DISCUSSION: Although Type II odontoid fractures are associated with a high mortality rate, research efforts have focused on whether operative vs. nonoperative management influences survival time. Here we show that pre-injury health status better accounts for the paradoxically high mortality rate.

CONCLUSION: This initial finding suggests that Type II odontoid fractures reflect a culmination of overall health deterioration. Future studies may delineate whether similar findings are present in other patient populations with high mortality rates.

Paper 170

Outcomes of Elective LuM.B.A.r Decompression and Decompression with Fusion Procedures in Octogenarians

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INTRODUCTION: Octogenarians are currently one of the fastest growing age demographics in the United States. As the population continues to age and life expectancy increases, more elderly individuals are pursuing elective procedures, including spine surgery. The purpose of this study is to assess the incidence of and risk factors for short-term complications in elderly patients undergoing elective posterior lumbar decompression or decompression and fusion procedures.

METHODS: Patients that underwent elective, single-level, posterior decompression or decompression and fusion procedures between January 1, 2015 – December 31, 2017, were identified in the American College of Surgeons' National Surgical Quality Improvement Program (ACS NSQIP) database. Exact matching was used to match patients aged 80 years and older to patients between 65-79 years-old based on sex, American Society of Anesthesiologists (ASA) class, body mass index (BMI), functional status, and several medical comorbidities. The rate of various 30-day outcomes – unplanned readmission, reoperation, prolonged length-of-stay, non-home discharge, mortality, surgical and medical complications – were compared between the matched cohorts.

RESULTS: After exact matching, 10,434 patients were included in the final analysis with 7,692 patients who underwent decompression alone and 2,742 patients who underwent decompression and fusion procedures. Within the decompression alone cohort, octogenarians were met with significantly higher rates of readmission, non-home discharge, prolonged length-of-stay, perioperative bleeding, and overall medication complications ($p < .001$ for all comparisons). Within the fusion cohort, octogenarians faced significantly higher rates of non-home discharge, bleeding, and urinary tract infections ($p < .001$ for all comparisons). When compared to octogenarians who underwent decompression procedures alone, those who underwent single-level fusion procedures had a higher rate of readmission, non-home discharge, prolonged length-of-stay, and overall medical and surgical complications. Risk factors for readmission facing octogenarians undergoing decompression only included a history of COPD, steroid use, ASA class III, and partially dependent functional status. Risk factors for readmission after fusion procedures included obesity class I or greater.

CONCLUSION: Octogenarians are at higher risk for postoperative complications following elective lumbar spine surgery than their younger counterparts. Furthermore, octogenarians who undergo decompression and fusion are at higher risk for postoperative complication when compared to those who undergo decompression alone. Several identifiable risk factors were predictive of these poor short-term outcomes. While certain elderly patients may be appropriate candidates for elective spine surgery, these patients should be selected carefully to minimize the morbidity and poor short-term outcomes.

Paper 172

Analysis of Spine Range of Motion and Muscle Activity in Rowers

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BACKGROUND: Lumbar spine injuries are common injury in rowers. Previous studies have shown ergometer training to be associated with an increased risk of injury.

PURPOSE: To (1) evaluate how muscular activation relates to lumbar spine mechanics and (2) evaluate the effect of fatigue on back muscle activation.

METHODS: Seventeen amateur rowers were recruited and consented to participate (σ 8; 39.5 ± 12 yrs, 83 ± 12 kg, 182 ± 8 cm; φ 9; 38 ± 7.6 yrs, 63 ± 10 kg, 163 ± 10 cm). During testing, biomechanical assessment of spine flexion ROM, muscle activity, and pull force was conducted using a 12-Camera Vicon motion capture system and 8-channel wireless EMG (Delsys®) during a timed maximal effort 2000m row test (Concept2 Model D row ergometer) with data collection (10-seconds) at the 200m, 600m, 1000m, 1400m, and 1800m distances. Spine flexion was calculated at three points in the sagittal plane of the body and labeled as upper, mid, and lower spine. A mixed model ANOVA repeated on rowing distance was used to compare hip ROM and pull force at each distance interval. Type-I error was set at $\alpha = 0.05$.

RESULTS: Average time to complete the bout was 8.4 ± 1.0 min for the group (262.3 ± 55.2 total strokes). Trapezius and mid spinal erector activation was maintained through the entire row. Results for change in muscle activation over time for the latissimus dorsi and lumbar spinal erectors, indicating potential fatigue of the musculature of the upper back followed by compensatory reliance on low back musculature to maintain/increase force output. Results for upper and mid spinal flexion measures, a general rounding of the mid and upper spine was observed in conjunction with fatigue of the upper back muscles. No changes were observed in lumbar spinal flexion.

CONCLUSION: Low back pain and injuries associated with rowing may not be a result of altered flexion/extension of the lumbar spine, but rather a result of increased workload placed on low back musculature to compensate fatiguing muscles and concomitant changes in the row mechanics of the upper and mid spine. Although often considered a form of "low impact" aerobic training, given the high number of contractions over a short time interval (<10 min), it may be advisable for those interested in rowing to avoid consecutive or multiple days of fatiguing row ergometer training per week or performing rowing and lower body resistance training bouts in close proximity.

Paper 173

Surgeon and EOS Agreement of Spinal Sagittal Plane Parameters

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BACKGROUND: EOS imaging provides low-dose radiation radiographs of the spine and generates measurements of coronal and sagittal plane parameters. Recent studies have shown that surgeons over-estimate thoracic kyphosis. Although studies have shown good interobserver agreement of EOS-generated measurements, the purpose of this study is to evaluate how surgeon-measured parameters compare with EOS. Our secondary objective evaluated the role of Cobb angle, lumbar modifier, and body mass index (BMI) on agreement of measurements.

METHODS: EOS imaging obtained on 74 consecutive patients with AIS were reviewed. Spinal sagittal plane parameters were measured by two surgeons and compared with EOS measurements. The reviewers were blinded. Intraclass correlations (ICC) between the surgeons and the surgeons/EOS were calculated. The agreement between the surgeons/EOS was compared for the following subgroups: major Cobb angle <70° vs >70°, lumbar modifier A vs B/C, and BMI of <24.5 vs ≥ 24.5.

RESULTS: For the surgeons, agreement was good for all parameters except pelvic tilt (PT) and sacral slope (SS), which had excellent agreement. Agreement for all parameters when the surgeons were compared to EOS were good except PT and SS, which had excellent agreement. Subgroup analysis showed: 1) T4-12 kyphosis was good in the Cobb angle <70° group and moderate in the Cobb angle >70° group; 2) PI was excellent in the Cobb angle <70° group and good in the Cobb angle >70° group; 3) SS was excellent in the Cobb angle <70° group and good in the Cobb angle >70° group; 4) L1-S1 lordosis was good in the BMI <24.5 group and moderate in the BMI ≥24.5 group; 5) PI was good in the BMI <24.5 group and excellent in the BMI ≥24.5 group; 6) SS was good in the BMI <24.5 group and excellent in the BMI ≥24.5 group; 7) L1-S1 lordosis was good in the lumbar modifier A group and moderate lumbar modifier B/C group; 8) PI was excellent in the lumbar modifier A group and good in the lumbar modifier B/C group; 9) SS was excellent in the lumbar modifier A group and good in the lumbar modifier B/C group. In all instances, the ICCs overlapped with the 95% confidence intervals.

CONCLUSION: EOS shows good to excellent interobserver agreement between surgeons and surgeons and EOS. Our subgroup analysis revealed that some variables may have an impact on agreement. However, the ICCs overlapped with the 95% CIs, calling into question whether a meaningful difference exists.

Paper 174

The Incidence and Evaluation of Postoperative Dysphagia Following an Anterior Cervical Discectomy and Fusion

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BACKGROUND: Postoperative dysphagia is a known complication of an anterior cervical discectomy and fusion (ACDF) with reported incidences ranging from 1-79%. There are no standardized guidelines for spine surgeons – orthopedic and neurosurgeons alike - to evaluate postoperative dysphagia after ACDF. A systematic method may be beneficial in distinguishing transient postoperative dysphagia secondary to intubation from those with postoperative complications. Anterior lumbar discectomy and fusion (ALDF) is representative of a comparable anterior surgical approach which avoids anatomical structures critical to swallowing; consequently, this may be an acceptable cohort for comparison to evaluate and standardize dysphagia risks relating to intubation vs. manipulation of the surgical corridor leading to the anterior cervical spine. This study aims to evaluate the incidence, recognition, clinical evaluation, and utilization of specialists in managing postoperative dysphagia following ACDF.

METHODS: This is a retrospective case series of 345 patients who received either an ACDF or ALDF between the years 2005-2019. International classification of disease (ICD) and current procedural terminology (CPT) codes were used to identify patients experiencing dysphagia symptoms after ACDF or ALDF. Demographics, operative details, and clinical outcomes were reviewed. Swallowing diagnostics including modified barium swallow, barium esophagram, manometry, and laryngoscopy were also evaluated. Exclusion criteria included history of head and neck procedures, cancer, stroke, radiation, and trauma.

RESULTS: Two hundred and forty-one ACDF procedures and 104 ALDF were done at our institution with 131 and 93 patients meeting inclusion criteria, respectively. Of these patients, 27 (20.6%) ACDF and 4 (4.3%) ALDF patients were diagnosed with postoperative dysphagia within one year. Patients with operative intervention on levels C4-6 had the highest incidence of developing postoperative dysphagia. Less than half of the patients who were diagnosed with dysphagia during their first year following surgery had the word "dysphagia" documented in their one-month follow up visit with a spine surgeon. Only 66% of patients with dysphagia were evaluated by a dysphagia specialist and only a third of those patients were referred by their surgeon. Only six patients received diagnostic barium swallow evaluations.

CONCLUSION: There is a significant increase in risk associated with postoperative dysphagia in ACDF procedures compared to standard intubation risk as extrapolated using our ALDF control group. There is limited documentation of a standardized evaluation or intervention protocol circumventing this complication in the spine surgical community. Patients may benefit from more aggressive pre- and postoperative screening, evaluation, referral, and intervention regarding dysphagia symptoms following an ACDF.

Paper 175

Improved Cervical Sagittal Alignment Predicts Better Patient Reported Outcomes following Long Posterior Fusion

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OBJECTIVE: Limited evidence exists regarding the impact of preoperative and postoperative cervical sagittal alignment (CSA) on patient reported outcome measures (PROMs) following long PCF, and no study has reported on the impact of concomitant changes in CSA parameters on PROMs. The purpose of this study was to compare patient reported outcomes measures (PROMs) following long posterior cervical fusion (PCF) based upon perioperative cervical sagittal alignment.

METHODS: We performed a retrospective review of a prospectively maintained database of patients who underwent 5 or more levels of PCF that crossed the cervicothoracic junction between the years 2015 to 2020. C2 SVA and C2-7 lordosis, were assessed on radiographs performed preoperatively and at the 6- to 9-month postoperative follow-up appointment. PROMs were compared based upon preoperative, postoperative, isolated change, and concomitant changes in C2 SVA and C2-7 lordosis.

RESULTS: A total of 85 patients were included in this study. Patients with preoperative C2 SVA <40 mm had a larger improvement in VAS pain scores at 3 months postoperative (-4.9 vs. -3.0, $p = 0.03$) and a larger decrease in NDI scores at 6 months postoperative (7.2 vs. 3.1, $p = 0.04$) than patients with C2 SVA >40 mm. Patients with postoperative C2 SVA <40 mm demonstrated lower VAS pain scores at 3 months postoperative (2.0 vs. 3.4, $p = 0.049$). The cohort of patients with a decrease of C2 SVA by >5 mm demonstrated lower NDI at 3 months postoperative in comparison to patients whose C2 SVA increased or remained unchanged (11.7 vs. 23.8 vs. 18.2; $p < 0.001$). Patients in whom both C2 SVA and C2-7 lordosis improved demonstrated superior NDI ($p < 0.001$) and VAS scores ($p = 0.007$) at 3 months postoperatively compared to patients with less favorable concomitant changes in these parameters.

CONCLUSION: In patients undergoing long PCF, combined improvements in C2 SVA and C2-7 lordosis were the strongest predictors of improved early postoperative outcomes.

Paper 176

Are Minimum Two-Year PROMS Necessary for Accurate Assessment of Patient Outcomes after Primary TKA?

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BACKGROUND: The two-year minimum follow-up after total knee arthroplasty (TKA) required by most academic journals is based on historical implant survivorship studies rather than patient-reported outcome measures (PROMS). Additionally, the COVID-19 pandemic placed an unprecedented burden on staff and halted asymptomatic clinic visits to minimize in-person exposure. The purpose of this study was to determine if clinically meaningful differences are observed in PROMS beyond the first year following TKA.

METHODS: A retrospective review of prospectively collected PROMS for 1,093 primary TKAs at an academic center was performed. Changes in pain, function, activity level, and satisfaction were compared at four follow-up intervals—preoperatively, 4-months, 1-year, and minimum 2-years using repeated measures analysis.

RESULTS: Response rates for preoperative, 4-month, 1-year, and minimum 2-year PROMS were 88.2%, 69.9%, 63.6%, and 55.7% respectively. Pain with Knee Society level walking and while climbing stairs, UCLA activity level, and KOOS Jr. scores improved from preoperative levels at 4-months, 1-year, and minimum 2-years. Patient satisfaction also improved over postoperative follow-up intervals (84.0%, 87.3%, 90.9%). While PROMS improved with statistical and clinical significance preoperatively to 4-months to 1-year ($p \leq 0.082$), improvements from 1-year to minimum 2-year follow-up were small and did not reach MCIDs for most PROMS demonstrating significant overlap of 95% confidence intervals.

CONCLUSION: While long-term follow-up after TKA remains important for implant survivorship and function, with the numbers available one-year PROMS were as clinically reliable and meaningful as two-year PROMS. These findings question the necessity of in-person visits to collect PROMs beyond 1-year and suggest that 1-year outcomes are reliably predictive of longer-term outcomes for peer-reviewed publication.

Paper 177

Osteoarthritic Severity in Unresurfaced Patellae Does Not Adversely Affect PROMS in Contemporary TKA

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BACKGROUND: Selective patella resurfacing during total knee arthroplasty (TKA) is experiencing a resurgence as the value of universally resurfacing the patella with modern patella-friendly implants in contemporary TKA is questioned. However, as we define criteria for selective patella resurfacing, the degree of osteoarthritis (OA) acceptable to leave a native patella unresurfaced remains unknown. This study's purpose was to examine the effect of patellofemoral OA severity on PROMS at minimum one-year in primary TKAs performed without patellar resurfacing.

METHODS: 195 TKAs without patellar resurfacing were retrospectively reviewed. Preoperative patellofemoral OA was assessed in medial and lateral facets and graded on severity, marginal osteophytes, and joint space narrowing using Kellgren-Lawrence (KL) and OARSI atlas grading systems. All TKAs were performed using contemporary implants and modern perioperative protocols. Prospectively collected PROMS were evaluated at minimum one-year follow-up in multivariate statistical models controlling for demographics and covariates.

RESULTS: The cohort was 53% female with mean age and BMI of 61 ± 11 years and 35 ± 8 kg/m². In multivariate regression, lateral patella KL grade of ≥ 2 was associated with lower pain scores and higher KOOS JR scores ($p \leq 0.013$), and a knee 'always feeling normal' at minimum one year (OR 2.37, 95%CI: 1.14-4.90, $p = 0.020$). OA severity via marginal osteophyte and joint space narrowing grades were not associated with any PROMS in multivariate analysis with numbers available.

CONCLUSION: Interestingly, worse preoperative OA severity in the lateral patellar facet, graded with the KL system, predicted superior knee-specific PROMS in patients with unresurfaced patellae after contemporary TKA. This observation supports the clinical finding that patients with more severe OA have optimized patient satisfaction, and highlights the minimal contribution of patella OA to knee function after TKA for tibiofemoral disease. Further research is warranted to delineate selective patella resurfacing criteria for optimal TKA outcomes.

Paper 178

Survivorship Analysis of Cementless Total Knee Arthroplasty with and without Patellar Resurfacing

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INTRODUCTION: Cementless total knee arthroplasty is becoming more prevalent due to improvements in new generation systems. Follow-up data of newer designs is limited in literature, including the impact of patellar resurfacing on these systems. The purpose of our study was to evaluate patient outcomes and complications at mid-term follow-up from cementless total knee arthroplasty with and without patellar resurfacing.

METHODS: A retrospective review was completed on 217 consecutive cementless total knee arthroplasties conducted by a single fellowship-trained surgeon at an urban, academic hospital center. Outcomes followed include surgical site infection (SSI), prosthetic joint infection (PJI), deep venous thrombosis (DVT), pulmonary embolism (PE), component loosening, periprosthetic fracture, extensor failure, and revision. Student's t-test, Pearson's chi-square test, multivariate logistical regression, and Kaplan-Meier survivorship analyses were completed.

RESULTS: There was an average of 4.8 years of follow-up prior to retrospective review. Complication incidences were: 0.5% SSI and PJI, 1.4% DVT with subsequent PE, 1.4% periprosthetic tibial fracture, 0.5% extensor failure, 2.8% loosening, and 3.2% all-cause revision. 153 patients were found to not undergo patellar resurfacing and 64 patients did undergo patellar resurfacing. No differences were found between the two groups with regards to demographics, operative time, component loosening incidence, or all-cause revision.

CONCLUSION: Assuming appropriate component positioning, cementless total knee arthroplasty demonstrated all-cause revision rates comparable to published rates of midterm revision rates in cemented total knee arthroplasty. Despite the theoretical risk of developing symptomatic patellofemoral osteoarthritis in patients who do not undergo patellar resurfacing, our cementless total knee arthroplasty cohort did not have any differences in all-cause arthroplasty revision at mid-term follow-up. Further long-term follow-up may support the elimination of patellar resurfacing in the context of cementless knee arthroplasty.

Paper 179

Home Health Care in Medicare-aged Patients Is Associated With Increased Early Emergency Visits, Readmissions, and Costs Following Total Knee Arthroplasty

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INTRODUCTION: Some practices routinely provide patients with home health services believing that they are beneficial to assist with care and monitoring in the early postoperative period following total knee arthroplasty (TKA). The purpose of this study is to determine whether patients receiving home health services postoperatively had lower rates of complications, emergency room visits, and readmissions as well as to determine if home health provided value by reducing total episode-of-care costs.

METHODS: We reviewed the Humana claims database to identify all primary TKA patients over 65 years old from 2010-2018. Patients who received home health services were matched using a propensity score algorithm to a set of similar patients that were discharged home without home health services. We compared complication rates, emergency room visits, readmissions, and 90-day episode-of-care claims costs between matched and unmatched groups. Multivariate regression analysis was performed with patient age, sex, and CCI used as covariates to determine the independent effect of home health services on emergency department (ED) visits and hospital readmissions.

RESULTS: Of the 185,444 TKA patients discharged home, 15,849 (8.5%) received home health services. Patients who received home health services had higher rates of ED visits at 2 weeks (3.3% vs. 2.8%, $p = 0.014$) and 3 months (7.1% vs. 6.5%, $p = 0.038$) as well as increased readmissions at 2 weeks (0.9% vs. 0.7%, $p = 0.028$); complication rates were similar between groups (11.4% vs. 10.9%, $p = 0.159$). Episode-of-care costs for home health patients were higher than those discharged under self-care (\$24,266 vs. \$22,539, $p < 0.001$).

CONCLUSION: Home health services do not appear to provide value as they are associated with significantly increased costs and do not lower the rates of complications, ED visits, or readmissions following TKA.

Paper 180

Early Outcomes Using the Posterior Stabilized ATTUNE® Revision System in Revision Total Knee Arthroplasty (RTKA): Interim Results from an International, Multi-center, Post-Market Study

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INTRODUCTION: The posterior stabilized (PS) ATTUNE® Revision system is relatively new with few short- or medium-term results reported. It offers compatibility with the ATTUNE® Primary knee, allowing for partial revisions when one component remains well fixed. Although the existence of a compatible revision system is not unique to ATTUNE®, the benefit of having a primary-compatible revision system increases the options for surgeons during revision procedures. This post-market interim evaluation presents the clinical performance and survivorship of one-year data.

MATERIALS & METHODS: From Dec 2017 through May 2021, 37 investigators prospectively enrolled and treated 332 subjects with a PS ATTUNE® system into this non-comparative study. Subjects received either Posterior Stabilizing Fixed Bearing (PSFB) or Posterior Stabilizing Rotating Platform (PSRP) configurations (108 PSFB, 224 PSRP). Results (mean(SD)) include one-year patient reported outcome measures (PROMs) and Kaplan-Meier (KM) device survivorship.

RESULTS: Age and BMI were similar for both configurations: 64.5(8.8) and 31.2(5.6) for PSFB and 65.6(7.9) and 32.4(6.3) for PSRP. PSFB and PSRP groups were 54.6% and 46.9% female, respectively. Pain catastrophizing scale was 25.9(22.3) and 21.2(15.8) at baseline. Percentages of subjects receiving femoral stem, sleeve, and augment were 86.1%, 6.5%, and 73.1% for PSFB and 82.6%, 51.3%, and 82.6% for PSRP. Percentages of subjects receiving tibial stem, sleeve (available PSRP only), and augment were 98.1%, 0%, and 21.3% for PSFB and 90.2%, 88.0%, and 8.0% for PSRP. One-year follow-up is currently 68.5% (74/108) for PSFB and 71.9% (161/224) for PSRP. There were 7 re-revisions (removal of any component) prior to one year (1 PSFB, 6 PSRP). KM device survival estimates at one year (95% confidence intervals) were: PSFB: 99.1% (93.6%, 99.9%); PSRP: 97.3% (94.1%, 98.8%). Reasons for these re-revisions included infection (4, of which 2 were insert exchange), peri-prosthetic fracture after a fall (1), suture rupture (1, insert exchange), hematoma (1, insert exchange). The number with follow-up beyond one year was 79 for PSFB and 201 for PSRP. Significant improvement from preoperative to 1-year postoperative was observed in all PROMS and subscales: PKIP, KOOS-PS, EQ-5D-5L, Health VAS score, and all AKS Subject and Surgeon reported results (all p-values <0.001).

CONCLUSION: These early results suggest the PS ATTUNE® Revision system is well-tolerated and provides good patient- and surgeon-reported outcomes at one-year post-surgery with no evidence of design issues leading to early mechanical failures. We note that there were no revisions for aseptic loosening.

Paper 181

The Cost-Effectiveness of Tibial Metaphyseal Cones in Revision Total Knee Arthroplasty

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INTRODUCTION: Tibial cones have been successfully used to address contained bone defects in revision total knee arthroplasty (TKA). Cones potentially decrease the rate of aseptic loosening through improved fixation, but it remains unclear whether this justifies the additional cost. The purpose of this study was to evaluate the cost-effectiveness of tibial cones in revision TKA.

METHODS: A Markov decision model was used for cost-effectiveness analysis. The average selling prices of all commercially available tibial cones were obtained from Orthopedic Network News. The average aseptic loosening rate of a tibial cone was determined by a literature review of 21 studies (607 cones). Inflation-adjusted hospitalization costs and baseline 5-year re-revision rates were calculated using the PearlDiver Database during 2010-2020.

RESULTS: The maximum cost-effective cone price varied from \$3,514 at age 40 to \$648 at age 90, compared to the current average price of \$4,201. Cones became cost-effective when the baseline (non-cone) aseptic loosening rate ranged from 0.89% annually at age 40 to 4.38% annually at age 90, compared to the current average rate of failure without cones of 0.76% annually. For patients with an expected 5-year aseptic loosening rate of 5%, cones became cost-effective for patients ≤ 50 years old; at an expected aseptic loosening rate of 7%, cones were cost-effective for patients ≤ 60 years; at 10%, cones were cost-effective for patients ≤ 70 years; at 15-20%, cones were cost-effective for patients ≤ 80 years. At a price of \$3,000, cones were cost-effective for patients ≤ 50 years old; at \$2,000, cones were cost-effective for patients ≤ 70 years; at \$1,000, cones were cost-effective for patients ≤ 80 years.

CONCLUSIONS: For the average patient undergoing revision TKA, tibial cones are not cost-effective. Cones may become cost-effective at lower prices, in younger patients or in patients at substantially increased risk of aseptic loosening.

Breakout Session #13 (Knee Arthroplasty)
Saturday, April 09, 2022

Paper 182

Similar Outcome Between Native and Periprosthetic Fractures of the Distal Femur

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INTRODUCTION: Despite the rising prevalence of arthroplasty and aging population, limited data exists regarding differences in periprosthetic fracture clinical outcomes compared to native counterparts. This study compares differences in hospital treatment, morbidity, and mortality associated with periprosthetic distal femur fractures at an urban level 1 trauma center.

METHODS: We retrospectively reviewed all adult AO/OTA type 33 fractures (526) that presented to our institution between 2009-2019. 54 native and 54 periprosthetic fractures were matched by age and gender. We recorded demographics, operative measures, length of stay (LOS), discharge disposition, and mortality. We used McNemar's and Paired t-tests for analysis where appropriate ($p < 0.05$). (IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.).

RESULTS: The average age at injury was 74 years \pm 12 (native) compared to 73 years \pm 12 (periprosthetic). After 1:1 matching, the groups had similar BMI (31.01 vs. 32.98, $p = 0.966$ for native and periprosthetic, respectively) and mechanisms of injury with 38 native and 44 periprosthetic ($p = 0.198$) from low energy falls. Both groups had 51/54 fractures managed with Open Reduction Internal Fixation with a locking plate. The remaining were managed via amputation or intramedullary nail fixation. Mean operative time (144 min (\pm 64) vs. 132 min (\pm 62) ($p = 0.96$) and estimated blood loss (EBL) 319 mL (\pm 362) vs. 289 mL (\pm 231) ($p = 0.44$)) were comparable between the native and periprosthetic groups, respectively. LOS was 9 days \pm 7 (native) compared to 7 days \pm 5 (periprosthetic, $p = 0.31$), discharge disposition $n = 47$ (native) to SNF/rehab and $n = 43$ (periprosthetic, $p = 0.61$) and mortality $n = 6$ (native) vs. $n = 8$ (periprosthetic, $p = 0.55$). No significant differences were observed.

CONCLUSION: We found no statistical differences in morbidity and mortality in periprosthetic distal femur fractures treated over 10 years at a level 1 trauma center. Native and periprosthetic AO/OTA type 33 distal femur fractures are serious injuries with similar outcome at a level 1 trauma center.

Paper 183

Spinal Anesthesia vs. General Anesthesia in Contemporary Primary Total Knee Arthroplasties

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INTRODUCTION: Spinal anesthesia (SA) has seen increased utilization in contemporary total knee arthroplasties (TKAs). However, controversy exists about the benefits of SA in relation to general endotracheal anesthesia (GETA). This study aimed to investigate the pain control, length of stay (LOS), and complications associated with modern SA vs. GETA in a large cohort of primary TKAs from a single, high-volume academic institution.

METHODS: We retrospectively identified 17,866 primary TKAs (13,473 patients) from 2000 to 2016 using our institutional total joint registry. 52% had GETA and 48% had SA. Baseline characteristics were similar between cohorts with a mean age of 68 years, 57% female, and mean body mass index of 32 kg/m². Pain was assessed by oral morphine equivalents (OMEs) and numeric pain scale (NPS) scores. Complications including 30-day and 90-day readmissions were studied. Data were analyzed using an inverse probability of treatment weighted model based on propensity score that accounted for age, sex, BMI, ASA score, Charlson comorbidity index (CCI), operative diagnosis, operative time, year of surgery, and surgeon utilization of SA. Mean follow-up was six years.

RESULTS: Patients treated with SA required fewer postoperative OMEs ($p < 0.001$) and had lower mean NPS scores ($p < 0.001$). SA also had a shorter LOS (< 0.0001) with fewer cases of altered mental status (AMS; OR 1.3, $p = 0.04$), as well as less 30-day (OR 1.5, $p < 0.001$) and 90-day readmissions (OR 1.4, $p < 0.001$). No differences were observed in the incidence of VTE ($p = 0.5$) or reoperations for infection ($p = 0.2$).

DISCUSSION: In the largest single institutional report to date, we found SA was associated with significantly lower OME use, lower risk of AMS, and lower overall 30-day and 90-day readmissions following primary TKAs after accounting for numerous patient and operative factors. When possible, SA should be the preferred route of anesthesia in primary TKAs.

SUMMARY: SA was associated with improved perioperative pain control, reduced length of stay, and fewer postoperative complications and readmissions when utilized for contemporary primary TKAs.

Paper 184

Comparison of Anemia and Blood Transfusion after Single-Team and Two-Team Simultaneous Bilateral Total Knee Arthroplasty

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INTRODUCTION: Bilateral total knee arthroplasty (TKA) has become of interest due to the continuing rise in demand for TKA and high incidence of bilateral knee osteoarthritis. Current evidence on the safety of bilateral TKA remains conflicted. Additionally, most studies have failed to differentiate between one surgeon and two surgeon teams performing simultaneous bilateral TKA. The purpose of this study is to evaluate differences in rates of postoperative anemia and blood transfusion between single surgeon-team (stBTKA) and two surgeon-team simultaneous bilateral TKA (ttBTKA).

METHODS: Following IRB approval, a retrospective review of surgical records in a single healthcare system from 2014 to 2019 was performed. Patients who underwent simultaneous bilateral TKA were identified; 604 patients underwent stBTKA and 90 patients underwent ttBTKA. Demographic and perioperative data was collected. Statistical analysis was performed using Mann-Whitney U test for continuous variables and chi-squared or Fisher exact test for categorical variables with significance set at $p < 0.05$.

RESULTS: Demographics between groups were similar except for older age ($p = 0.030$) and higher body mass index ($p = 0.029$) in the ttBTKA group. Median operative time was 34 minutes shorter in the ttBTKA group ($p < 0.001$). Fewer patients in the ttBTKA group (26.7%) had postoperative anemia than in the stBTKA group (50.4%, $p < 0.001$). The rate of blood transfusion was also lower in ttBTKA (1.1% vs. 7.6%, $p = 0.023$). There was no difference in postoperative hematoma ($p > 0.999$), length of stay ($p = 0.336$), emergency department visits ($p = 0.451$), or readmissions ($p = 0.898$) within 90 days of surgery between ttBTKA and stBTKA.

CONCLUSION: Two-team simultaneous bilateral TKA demonstrates lower rates of postoperative anemia and blood transfusion compared to single-team bilateral TKA. Further research is necessary to compare complications and outcomes of single-team and two-team simultaneous bilateral TKA.

Paper 185

Intraosseous Morphine Decreases Postoperative Pain and Opioid Consumption in Total Knee Arthroplasty: A Prospective, Double-Blind, Randomized Controlled Trial

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INTRODUCTION: Pain following total knee arthroplasty (TKA) can be difficult to manage despite multimodal regimens. Intraosseous (IO) administration of medication is a novel technique, and this delivery method has been shown to increase local tissue concentration of vancomycin with low systemic levels during TKA. The primary purpose of the present study was to determine if IO morphine is a safe and effective method to decrease pain and reduce opioid consumption following primary TKA.

METHODS: A prospective, double-blind, randomized controlled trial was performed on 48 consecutive patients undergoing primary TKA. After tourniquet inflation and prior to skin incision, IO vancomycin (500mg in 150mL normal saline) was administered near the tibial tubercle with no morphine (24 patients, control group) or 10 mg of morphine (24 patients, experimental group). In a subset of 20 patients (10 control, 10 experimental), a blood sample was taken 10 hours after IO injection to measure systemic levels of morphine and interleukin-6 (IL-6). A symptom journal was completed for the first 14 days postoperatively to record pain and nausea visual analog scale (VAS) scores and opioid consumption (morphine milligram equivalents, MMEs). Patients completed PROMIS Global Health SF v1.1 and KOOS JR questionnaires preoperatively and at their follow-up appointments.

RESULTS: Postoperative VAS pain scores demonstrated statistically significant improved scores for the experimental group at hours one ($p = 0.032$), two ($p = 0.005$), three ($p = 0.02$), and five ($p = 0.01$). This trend continued for postoperative day one ($p < 0.001$), two ($p = 0.036$), eight ($p = 0.025$), and nine ($p = 0.041$). The experimental group recorded a 35% reduction in MMEs on postoperative day one ($p = 0.018$). MMEs were reduced by 26% over the first 48 hours ($p = 0.011$) and by 32% over days 8-14 ($p = 0.041$). Serum morphine levels in the experimental group were significantly less than in the control group 10 hours after the IO injection ($p = 0.049$). Serum IL-6 levels were observed to be significantly elevated in both groups 10 hours after the IO injection ($p < 0.001$) with no difference between groups. At eight weeks post-surgery, KOOS JR scores were significantly improved for both groups ($p < 0.001$) with the experimental group recording a significantly greater score than the control group ($p = 0.018$).

CONCLUSIONS: IO morphine demonstrates significantly improved postoperative pain relief immediately and up to two-weeks post-surgery with decreased opioid consumption. IO morphine is a safe and effective method to reduce postoperative pain in TKA patients.

Paper 186

Robotic-Assisted Total Knee Arthroplasty: Is there a maximum level of efficiency for the operating surgeon?

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INTRODUCTION: Recent studies have attempted to quantify the learning curve associated with integration of robotic technology into surgical practice, but to our knowledge, no study has demonstrated the number of cases needed to reach a steady state of maximum efficiency in operating times using robotic assisted technology. Our hypothesis was that surgeons completing total knee arthroplasty (TKA) with robotic assistance would experience decreased operative times with subsequent procedures performed, eventually reaching a steady efficiency level at which surgical operating times would plateau, but not decrease further.

METHODS: This was a retrospective analysis of 682 consecutive knees that underwent a robotic-assisted TKA for osteoarthritis by a single surgeon between 2017-2020. Procedure times (minutes), length of stay (LOS), and short-term postoperative complications and reoperations were analyzed to define trends. Time series analyses were used to identify the approximate time-point at which a maximum level of surgical operating speed was achieved. Analysis of Variance (ANOVA) and chi-square analyses then followed to compare average procedure duration, LOS, and complications across distinct moving groups of 50 procedures.

RESULTS: Time series analyses suggest substantially improved times by the 50th procedure and reached a stable plateau between the 150th and 200th procedure. Average duration for the first 50 procedures was approximately 85 minutes, dropping to 69 minutes for procedures 51-100, 66 minutes for procedures 101-150, and then plateauing at approximately 61 minutes for procedures 151-682, demonstrating significant improvements in surgical efficiency at each 50-procedure interval ($p < 0.05$). There was no significant difference in LOS, readmissions, and reoperations with increasing groups of 50 procedures performed.

CONCLUSION: Results from this study will allow surgeons to better understand the implications of integrating robotic arm-assisted technology into their practice. Surgeons can expect significant improvement of their operative time following completion of at least 50 procedures, while likely reaching a maximum level of surgical efficiency between 151 and 200 procedures.

Paper 187

The Cost-Effectiveness of Robotic-Assisted Total Knee Arthroplasty: A Computer Model-Based Evaluation

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BACKGROUND: Robotic arm-assisted devices have been recently introduced in total knee arthroplasty (TKA) surgery, utilizing intraoperative bony registration and navigation features to measure alignment and perform bony cuts more precisely. This technology may improve component alignment and improve patient reported outcomes; nevertheless, robotic-assistance systems are associated with significant total costs, with estimates ranging from \$250,000 to \$1,500,000.

OBJECTIVE: The purpose of this study was to investigate the cost-effectiveness of robotic-assisted TKA vs. conventional-manual TKA in patients with knee osteoarthritis. A secondary aim was to study how the relative value of this procedure varies with changes in projected outcomes, complication rates, and costs.

METHODS: A Markov model was developed to simulate the probabilistic outcome of TKA over the lifetime of patients of age 60. Costs of a robotic-assisted TKA included a preoperative CT scan and the costs for acquisition and use of robotic equipment (average \$706,250). We utilized 3 institutional case volumes to generate average per-case robotic costs: low-volume (10 cases, \$71,025 per case), mid-volume (100 cases, \$7,463 per case), and high-volume (200 cases, \$3,931 per case). Outcomes were total costs and health outcomes measured in quality-adjusted life-years (QALYs). Costs and QALYs were organized into incremental cost-effectiveness ratios (ICERs), representing the difference in costs divided by the difference in QALYs between the two procedures. A procedure was considered cost-effective if its ICER fell below standardized willingness-to-pay (WTP) thresholds of \$50,000 and \$100,000/QALY. Sensitivity analyses evaluated the impact of data uncertainty by varying data points across discrete ranges found in the literature.

RESULTS: Robotic-assisted TKA produced 13.55 QALYs vs. 13.29 QALYs for conventional TKA. Total costs per case for robotic-assisted TKA were \$92,823 (low-volume), \$29,261 (mid-volume), and \$25,730 (high-volume) compared to \$25,113 for conventional TKA. The ICERs for robotic-assisted TKAs were \$256,055/QALY (low-volume), \$15,685/QALY (mid-volume), and \$2,331/QALY (high-volume). ICERs for mid- and high-volume institutions were well below WTP. The average number needed to treat was >42 and >24 robotic-assisted TKAs for institutional cost-effectiveness at the \$50,000 and \$100,000/QALY WTP, respectively. Robotic-assisted TKAs remained cost-effective for mid-volume institutions when annual TKA revision rates were <1.6% and quality of life values were >0.85.

CONCLUSION: With lower annualized revision rates and higher postoperative quality of life, robotic-assisted TKAs potentially offer improved health outcomes, especially when case volume exceeds 24 cases/year. Prospective investigation will be crucial to demonstrate the value of this technology.

Paper 188

Validation and Performance of a Machine-Learning Derived Prediction Guide for Total Knee Arthroplasty Component Sizing

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INTRODUCTION: Anticipation of patient-specific component sizes before total knee arthroplasty (TKA) can reduce costs and morbidity associated with imperfect sizing. Traditional templating methods are inconsistent and time-consuming. Machine Learning algorithms may allow for accurate and real-time component size predictions.

METHODS: Consecutive patients receiving primary TKA between 2012-2020 from two tertiary academic and six community hospitals were identified. Final femoral and tibial component sizes with dimensions were recorded. Five different algorithms were trained using age, height, weight, body mass index, and sex with 80% of the study population and internally validated on the remaining 20%. Performance was evaluated through accuracy, mean absolute error (MAE), and root mean-squared error (RMSE).

RESULTS: 17,283 patients receiving TKA were included. The stochastic gradient boosting (SGB) model accuracy for predicting within 4 mm of the true femoral anteroposterior diameter was 83.6% and for within 1 size of the true component was 95.0%. The SGB model accuracy for predicting within 4 mm of the true tibial medial/lateral diameter was 83.0% and for within 1 size of the true component was 97.8%.

CONCLUSION: ML algorithms demonstrated promising performance for predicting TKA component size. Further research is necessary to compare to other prediction models, as well as including additional predictive parameters such as race and implantation technique.

Paper 189

Repeated 2-stage arthroplasty to treat a failed 2-stage revision for periprosthetic hip or knee infection: A tertiary center experience

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INTRODUCTION: Persistent periprosthetic joint infection (PJI) after 2-stage revision ranges widely from 0% to 40%, and in many instances, another 2-stage is the chosen procedure. However, literature is still scarce on the outcomes of this repeated surgical undertaking as compared to the first 2-stage. Thus, the objective of this study was to determine and compare the outcomes between a repeated 2-stage (second or third) and first 2-stage revision for treatment of PJI.

METHODS: A retrospective review was conducted on a consecutive series of 1,015 revision total hip and knee arthroplasties, which were performed by 9 surgeons (2009-2020) at a single institution. After comprehensive review of the operative notes, 107 2-stage revisions were identified. The inclusion criteria were the completion of reimplantation and minimum follow-up of one year. Of 107, 95 2-stage revisions which met these criteria were finally included. Two-stage revisions were grouped as: first 2-stage (n = 82) and repeated (second, n = 12 and third, n = 1) 2-stage (n = 13). Demographic and surgical characteristics (mean operative time, blood transfusion requirements, length of hospital stay; emergency department (ED) visits) were compared between these 2 groups. Treatment success was defined by Musculoskeletal Infection Society (MSIS) outcome-reporting tool at minimum one-year follow-up and collected as: Tier 1 (infection control with no continued antibiotics), Tier 2 (infection control with suppressive antibiotics), Tier 3 (need for reoperation or spacer retention), and Tier 4 (death). Independent t-tests and chi-square tests were conducted. The statistical significance was set at p-value<0.05.

RESULTS: The mean follow-up for all 2-stage revisions was 29.8 ± 139.6 months. On comparing repeated and first 2-stage revisions, no significant differences were found in mean operative time (p = 0.057), transfusion requirements (p = 0.207), and length of hospital stay (p = 0.199). While repeated 2-stage patients visited ED more frequently (vs. first 2-stage; p = 0.002) within 90 days of surgery, there was no difference in reoperation rate, readmission rate and MSIS Tier (1/2 vs. 3/4) outcomes between patients who underwent repeated and first 2-stage revision.

CONCLUSION: This data suggests that repeated 2-stage revision results in outcomes comparable to the first 2-stage revision at minimum 1-year. In the setting of persistent PJI, it seems worthwhile to repeat 2-stage with no additional risk of adverse outcomes as compared to the first 2-stage revision.

Breakout Session #13 (Knee Arthroplasty)
Saturday, April 09, 2022

Paper 190

Identifying Total Joint Arthroplasty Patients at Risk for Active Dental Infection

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INTRODUCTION: Active dental infection at time of total joint arthroplasty (TJA) is thought to predispose to periprosthetic joint infection, leading many surgeons to prescribe preoperative dental screening. This study aimed to better understand dental hygiene practices in arthroplasty patients and identify dental specific risk factors for active dental infection.

METHODS: A total of 514 sequential elective, TJA patients were asked to complete an 8-question survey regarding their dental hygiene practices. Questions were chosen based upon previously reported risk factors for active dental infection in the dental and orthopedic literature. Additionally, all patients were scheduled to see a dentist preoperatively. Questionnaire responses were analyzed for association with active dental infection requiring an invasive dental procedure prior to TJA with univariate analysis.

RESULTS: In 103 cases (20%) patients failed dental screening and required invasive dental procedures prior to undergoing TJA. No dental visit in the past 12 months ($p < 0.0001$), regular tobacco use in the prior 12 months ($p = 0.0007$), patients who did not brush their teeth daily ($p = 0.0037$) or floss daily ($p = 0.01$), and patients with previously known dental needs ($p < 0.0001$) all were associated with need for invasive dental procedure prior to TJA.

DISCUSSION/CONCLUSIONS: Patients undergoing elective TJA failed their routine dental screening at a rate of 20% and several survey questions were predictive of need for dental work. Universal dental screening may not be necessary for all patients. Targeted screening of high-risk patients may help improve workflow and limit unnecessary dental visits. Application of a dental screening tool in preoperative clinics may help facilitate this. Work needs to be done to validate this screening tool prior to its implementation.

Paper 191

Costs Associated With Different Revision Types Commonly Used For the Treatment of Hip and Knee PJI

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INTRODUCTION: In a consecutive series, we sought to compare in-hospital costs and length-of-stay (LOS) associated with different revision types employed for treatment of total hip (THA) and knee (TKA) periprosthetic joint infections with those of aseptic revisions.

METHODS: Retrospective review of 1,335 consecutive THA/TKA revisions performed by 7 surgeons in a single institution (2015-2012). Exclusions: partial-arthroplasty/ORIF conversions, bilateral revisions performed on same admission, Girdlestones, fusions, procedures superficial to the deep fascia. After review of the operative note (and radiographs/labs/office notes if required), 1,256 unilateral THA/TKA revisions (983 patients) were included for statistical analyses. Revisions were set apart in the following groups: (1) aseptic (control) (n = 770), (2) irrigation & debridement (I&D) for PJI w/wo insert exchange (n = 37), (3) explantation w/wo spacer (n = 313), (4) spacer-exchange (n = 15), (5) second-stage reimplantation (n = 105), and (6) single-stage reimplantation (n = 16). In-hospital professional (i.e., surgeon, anesthesiologist, consulting physicians) and technical (i.e., room and bed, imaging, labs, implants, nursing) charges per case were provided by Enterprise Analytics. Total charges (professional+technical) were calculated. Costs are in thousands of dollars (\$1000 = 1K). Alpha was set at 0.05.

RESULTS: Overall, septic revisions (n = 486) had longer LOS than aseptic revisions (mean 6.6 vs. 2.8 days, $p < 0.001$). In-hospital charges were also significantly higher in septic revisions (total \$123K vs. \$86K, professional \$24K vs. \$16K, technical \$99K vs. \$69K) (all $p < 0.001$). LOS (days) and total charges of different revision types were: (1) aseptic (2.8, \$86K), (2) I&D (6.1, \$87K), (3) explantation (7.6, \$134K), (4) spacer-exchange (8.3, \$129K), (5) second-stage reimplantation (3.6, \$101K), and (6) single-stage reimplantation (5.9, \$123K) (all $p < 0.001$, ANOVA).

CONCLUSION: Septic revisions are significantly more expensive. A single I&D for PJI is as expensive as the average aseptic revision. For the treatment of PJI, from the financial standpoint, single-stage reimplantations represent by far the best value for society. Adjustment in reimbursement is needed.

Paper 192

Joint Line Elevation on PROMS After Contemporary Revision TKA: Is Traditional Teaching Still Valid?

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BACKGROUND: Joint line elevation in revision total knee arthroplasty (rTKA) has been considered a risk factor for inferior outcomes, engendering a dogmatic protocol of joint line restoration. However, this precedent is based upon historical data using rudimentary revision systems and unvalidated outcome measures. This study's purpose was to evaluate the effect of joint line elevation on validated patient-reported outcome measures (PROMs) using modern revision implants.

METHODS: 327 rTKAs performed at a single institution were reviewed. Surgical technique prioritized flexion-extension gap balancing and accepted joint line elevation if necessary to achieve a balanced flexion space. Radiographic measurements included change in joint line, change from "intended" (i.e. calculated anatomic/native) joint line, and change in posterior condylar offset. Prospectively collected PROMs were evaluated using multivariate regression.

RESULTS: The mean joint line elevation from preoperative and "intended" to postoperative joint line was 4.9 ± 5.7 mm and 7.2 ± 6.6 mm, respectively. The mean increase in additional posterior condylar offset was 1.0 ± 4.6 mm. Overall, 59%, 70%, and 70% of patients achieved the minimal clinically important difference (MCID) for KOOS, JR and Knee Society pain with level walking and stair climbing scores, respectively, at most recent follow-up. A 5 mm elevation from intended joint line was associated with a 4.3x (95% CI: 1.7–10.9) greater likelihood of achieving MCID for stair climbing pain. An increase in the joint line greater than 5 mm was not independently associated with a difference in any other PROM. Patients within ± 5 mm of the preoperative joint line were 3.9x (95% CI: 1.5–9.8) more likely to achieve the MCID for KOOS, JR.

CONCLUSION: In contemporary rTKA, recreating the joint line within 5 mm improves knee-specific health outcomes. However, joint line elevation to a boundary of approximately 5 mm improves postoperative stair climbing pain. These data support moderate joint line elevation as a viable technique to optimize flexion-gap balance and subsequent patient outcomes in rTKA.

Paper 193

Hypoalbuminemia Increases Mortality after Two-Stage Revision Total Joint Arthroplasty

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INTRODUCTION: Hypoalbuminemia has been associated with worse outcomes after primary and aseptic revision total joint arthroplasty, but its role in periprosthetic joint infection (PJI) is unclear. The purpose of this study was to evaluate the effect of hypoalbuminemia on failure rates and mortality after two-stage revision for PJI.

METHODS: 199 Patients (130 knees and 69 hips) with a mean age of 64.7 ± 10.7 years who underwent a two-stage exchange between 2002 and 2019 for PJI were retrospectively reviewed at a mean of 51.2 ± 39.7 months. Rates of hypoalbuminemia, defined as serum levels <3.5 g/dL within 90-days preoperatively, all-cause mortality, and length of stay were evaluated. Failure of PJI treatment was defined as any revision within the follow-up period, failure to undergo reimplantation, or death within one year of initiating treatment.

RESULTS: Between successes (129 patients, 65%) and failures (70 patients, 35%), there were no significant differences in hypoalbuminemia rates (pre-stage 1 hypoalbuminemia: 44% vs. 41%, $p = 0.743$; pre-stage 2 hypoalbuminemia: 33% vs. 28%, $p = 0.714$). There were also no differences in hypoalbuminemia rates between the 38 septic failures and the rest of the cohort (pre stage 1: 42% vs. 43%, $p = 1.0$; pre-stage 2: 34% vs. 30%, $p = 0.674$). Pre-stage 2 hypoalbuminemia was a significant predictor of mortality based on both univariate (hazard ratio [HR] 3.26, 95% confidence interval [CI] 1.02-10.38, $p = 0.046$) and multivariate (HR 5.40, CI 1.19-24.54, $p = 0.029$) analysis. Hypoalbuminemia was associated with greater length of stay by 3.2 days after stage 1 ($p < 0.001$) and 1.7 days after stage 2 ($p < 0.001$).

CONCLUSIONS: Preoperative hypoalbuminemia is a significant predictor of mortality and increased length of stay following two-stage revision arthroplasty, but is not a predictor of success or failure of PJI treatment. Further study is required to understand if this is a modifiable risk factor or simply a marker for poor outcomes.

Paper 194

Postoperative Stiffness After Total Knee Arthroplasty in Patients with Prior ACL Reconstruction

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INTRODUCTION: Anterior cruciate ligament (ACL) reconstruction is a common procedure for restoring knee joint stability and improving function. Evidence suggests a higher incidence and younger patient age of total knee arthroplasty (TKA) after ACL reconstruction. Current literature is limited and conflicting regarding outcomes in this population. Consequently, it is unclear how to appropriately counsel these patients and mitigate potential risks. The purpose of this study is to determine the effect of previous ACL reconstruction on subsequent TKA outcomes and complications.

METHODS: This is a retrospective review of patients with previous ACL reconstruction who subsequently underwent TKA at our institution between January 2004 and November 2020. Electronic charts were queried for patient demographics, prior ACL reconstruction, pre- and postoperative range of motion (ROM), postoperative complications, and overall patient outcomes. Descriptive statistics were used to quantify these results.

RESULTS: We identified thirty TKAs in patients with prior history of ACL reconstruction with mean follow-up of 16.3 months (range 2-60). The mean age at ACL reconstruction and TKA was 33.9 and 54.3 years, respectively. The mean time elapsed between ACL reconstruction and TKA was 20.3 years (range of 4-41 years). Nine of 30 (30%) patients had decreased range of motion (ROM) compared to preoperative levels. In this group, the mean decrease in ROM was 21 degrees (range 3-55) and five patients (16.7%) had 100 degrees or less of total ROM at final follow-up. Three patients (10%) of the study population underwent reoperation. Two patients (6.9%) required MUA and both eventually underwent open lysis of adhesions for postoperative stiffness. One patient required revision for aseptic loosening. There were no other complications.

CONCLUSION: Patients undergoing TKA after ACL reconstruction are at risk for postoperative stiffness and the need for further intervention to address this complication. Surgeons should be aware of this risk to appropriately counsel patients and be vigilant in diagnosing and treating this complication.

Paper 195

Patient Satisfaction of Ambulatory Surgical Care Centers Compared to Hospital-based Outpatient Care

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INTRODUCTION: Total Knee Arthroplasty (TKA) is shifting from a predominantly inpatient procedure to an outpatient procedure. Operative outcomes and associated costs between outpatient and inpatient TKA are well established. However, there are few studies in the literature comparing patient satisfaction between the two settings. This study provides insight into how patients perceived inpatient and outpatient surgical settings. We hypothesize that patient satisfaction will be comparable between TKA patients of inpatient and outpatient settings.

METHODS: 134 patients undergoing primary TKA were prospectively enrolled. Same day TKA was performed at both facilities. TKA was performed by two surgeons at the outpatient facility, and a different two surgeons at an inpatient hospital. Patient satisfaction was measured using HCAHPS and S-CAHPS assessments. Descriptive numerical summaries and independent sample t-tests were calculated for continuous and categorical data, respectively.

RESULTS: Satisfaction between TKA patients at inpatient and outpatient facilities were statistically similar for Communication with Nurses ($p = 0.28$) and doctors ($p = 0.29$), Responsiveness to Hospital Staff ($p = 0.05$), Communication about Medicines ($p = 0.71$), Discharge information ($p = 0.61$), Cleanliness ($p = 0.77$) & Quietness of Hospital ($p = 0.75$), Overall Hospital Rating ($p = 0.90$), Surgeon rating ($p = 0.66$), and their final recommendation of the facility ($p = 0.06$). There was a statistically significant difference in the satisfaction of Care Transition ($p = 0.02$), as well as Surgical satisfaction ($p = 0.02$). Care Transition includes questions regarding the overall transition of care to the patient. Surgical satisfaction included questions about the patient's surgeon and the surgeon's visit(s) prior to surgery.

CONCLUSION: In this prospectively matched cohort study of 134 patients undergoing primary TKA, patient preference between inpatient and outpatient TKA was comparable for most categories. When discussing care transition and surgical satisfaction, patients preferred the inpatient facility. TKA in an outpatient facility is a viable option over surgery in inpatient facilities for qualifying patients. However, outpatient care for TKA is in its infancy and improvements can be made.

Paper 196

**Mid-Term Survivorship and Predictors of Failure of Medial Mobile Bearing
Unicompartmental Knee Arthroplasty**

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INTRODUCTION: Data on mid-term survivorship of the Oxford medial mobile bearing unicompartmental knee arthroplasty is largely derived from designer cohorts. Additionally, specific clinical and radiographic risk factors for UKA failure are incompletely understood. The purpose of this study was to perform a mid-term survivorship analysis of medial UKA from a single, non-designer surgeon, and to identify specific clinical or radiographic variables that may increase risk for UKA failure.

METHODS: Patients who underwent a mobile-bearing medial unicompartmental knee arthroplasty with a single surgeon from 2008-2019 were retrospectively identified; those with clinical follow-up ≥ 24 months were included. Patient demographics were recorded. Radiographic parameters, including Kellgren-Lawrence grade, Ahlback grade, combined Altman score of the lateral and patellofemoral joints at the time of surgery, presence of a lateral trochlear osteophyte on preoperative radiographs, and femoral and tibial component position in the coronal and sagittal planes were measured. Kaplan-Meier survivorship analyses were performed. Cox proportional hazards models were used to evaluate variables as risk factors for UKA failure. Endpoints were defined in 3 different ways: 1) any reoperation; 2) any component revision; 3) revision due to progressive osteoarthritis (OA).

RESULTS: 233 UKA in 177 patients were included. Mean age was 60 years, mean BMI 31.9 kg/m², and 62% of patients were female. Mean follow-up was 5.7 years (range, 2.0-13.1 years). Using any reoperation as an endpoint, 2-year survival was 96%, 5-year survival was 93%, and 10-year survival was 91%. Using any component revision as an endpoint, 2-year survival was 95%, 5-year survival was 95%, and 10-year survival was 93%. Lateral compartment Altman score ≥ 3 was associated with increased risk for any reoperation (Hazard ratio 4.9; 95% confidence interval 1.4-16.8) and any component revision (HR 12.4; 95% CI 3.7 – 41.2). Presence of a lateral trochlear osteophyte was associated with increased risk for any reoperation (HR 3.6; 95% CI 1.3-9.5) and increased risk of failure due to progressive osteoarthritis (Odds Ratio 46.9; 95% confidence interval 5.1-428.3).

CONCLUSION: In a single surgeon, non-designer series, medial mobile bearing unicompartmental knee arthroplasty demonstrates 93% survivorship at 10 years using an endpoint of any component revision. Presence of a lateral trochlear osteophyte was associated with an increased risk of failure due to progressive osteoarthritis. This is a novel risk factors that arthroplasty surgeons should be cognizant of at the time of indication for UKA.

Paper 197

Clinical and Radiographic Outcomes of Hybrid Glenoid Fixation with a Central Porous Titanium Post: Analysis of 714 Consecutive Shoulders

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INTRODUCTION: Hybrid glenoid component fixation represents an emerging technology in TSA design. However, there is a paucity of larger-scale studies reporting the outcomes following implantation of these components. This study aimed to determine the outcomes following primary TSA utilizing hybrid glenoid component fixation with a central porous titanium post.

METHODS: A retrospective review of two institutional databases identified patients ≥ 18 years who underwent a primary elective hybrid TSA between 2009 – 2018 with a minimum of 2 years of follow-up. Outcomes evaluated included visual analog scale (VAS) for pain, range of motion (ROM), American Shoulder and Elbow Surgeons (ASES) score, complications, and implant survivorship free of reoperation or revision. Postoperative imaging was assessed for glenoid radiolucent lines and evidence of AGL.

RESULTS: A total of 714 shoulders in 666 patients with a mean age of 61 ± 6 years and 50.9% men were included in the study at a mean follow-up period of 4.3 years (range 2.0 – 9.1 years). Notable clinical improvements were observed with respect to VAS pain (7.0 to 1.4; $P < .001$), active forward elevation (91° to 155° ; $P < .001$), active external rotation (21° to 50° ; $P < .001$), and ASES scores (38.6 to 82.7; $P < .001$) with all exceeding the substantial clinical benefit (SCB) threshold for TSA. Active internal rotation score also had significant improvement (3.1 to 5.7; $P < .001$). Glenoid radiolucent lines were identified in 57 (8.2%) TSA with 1 (0.1%) radiographically loose glenoid component. There were 54 (7.6%) complications with postoperative rotator cuff tear ($n = 15$; 2.1%) as the most common complication, and only 4 (0.6%) cases of glenoid related complications (AGL). Kaplan-Meier survival free from revision surgery was 98.7% at one year, 98.5% at two years, and 96.7% at five years.

CONCLUSION: Hybrid glenoid component fixation of anatomic total shoulder arthroplasty with a central porous titanium post demonstrated statistically significant and clinically meaningful improvements in pain, range of motion, and ASES scores. Though AGL remains a concern, only 0.6% of TSA sustained glenoid related complications at a mean follow-up period of 4.3 years and survivorship free of revision was 96.7% at five years. These favorable clinical findings support the theoretical advantages of hybrid glenoid fixation, however, large comparative investigations with long-term follow-up are needed to validate these results.

Paper 198

Patient-Reported Adverse Events after Total Shoulder Arthroplasty Where Liposomal Bupivacaine Blocks Were Used

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BACKGROUND: Liposomal bupivacaine is an attractive option for regional analgesia for total shoulder arthroplasty (TSA). There is growing support for its use as a preoperative interscalene block with current literature reporting 72 hours of effective pain management and decreased rates of opioid consumption postoperatively. However, there exists a paucity of data that discuss the risk for postoperative adverse events of liposomal bupivacaine compared to those who received non-liposomal bupivacaine. Therefore, our study aimed to compare the frequency of adverse events reported within the first 90 days following a TSA where either a liposomal bupivacaine block or non-liposomal alternative was used.

METHODS: 369 TSAs performed at a single institution were retrospectively reviewed from January 2011 to December 2018. Data abstraction included patient demographics, pertinent medical, social, and surgical history, as well as our final outcomes of interest—postoperative emergency department (ED) visits, readmissions following surgery, surgical complications, and patient-reported complaints late in the 90-day postoperative period (i.e., pain, paresthesia, and numbness). Case-control matching was done based on indications for surgery, social history, and preoperative comorbidities. Differences in outcomes were statistically assessed through chi-square tests and independent samples t-tests.

RESULTS: After exclusions, 362 cases were reviewed with a total of 83 cases where liposomal bupivacaine blocks were utilized. 71 of these cases were exact case-control matched to 71 cases where non-liposomal bupivacaine was used. 61% of this matched cohort was female with a mean age of 64 ± 11 years. With regard to our outcomes of interest, the frequency of return ED visits ($p = 1.0$), readmission ($p = 0.560$), and postoperative surgical complications ($p = 0.316$) did not statistically differ between the two groups. However, we did find a statistically significant difference between the rates of patient-reported complaints late in the 90-day postoperative period, with a higher frequency of complaints amongst those who received non-liposomal bupivacaine ($p = 0.034$).

CONCLUSION: Our study intends to contribute to the limited data available on adverse events following preoperative interscalene block with liposomal bupivacaine. Patients reported fewer complaints following TSA after receiving a liposomal bupivacaine block compared to the non-liposomal form. This supports the current rising trends and popularity of its use as a long-acting, regional analgesic. However, further research is warranted with a greater sample size to delineate any additional differences in adverse events that may exist.

Breakout Session #14 (Shoulder Arthroplasty)
Saturday, April 09, 2022

Paper 199

Optimal Treatment For Glenoid Bone Loss: Augmented Vs. Standard Reverse Shoulder Arthroplasty?

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BACKGROUND: Since the early 2000s, standard reverse shoulder arthroplasty (RSA) has seen an increase in indications and clinical application for the treatment of shoulder pathologies. With higher failure rates and poorer outcomes for glenoid bone loss in glenohumeral arthritis, augmented glenoid implants have shown encouraging results as a treatment for managing glenoid bone loss. With a lack of follow-up studies comparing the use of augmented RSA (aRSA) to standard RSA (sRSA), the decision is not always clear. This study will compare the postoperative outcomes between augmented and standard RSA.

METHODS: A retrospective review of 599 patients treated with RSA was performed. There were 203 patients in the aRSA group and 396 in the sRSA group. Demographic variables, glenoid version, range of motion (ROM), patient reported outcomes, and pain scores were collected preoperatively and postoperatively, with the addition of complications postoperative. Demographics, outcomes, and ROM for each group were compared and statistical analyses were performed.

RESULTS: There was a total of 376 males and 223 females with an average age of 73 years and average BMI of 29.4. The aRSA group had a mean glenoid version of -13.39° compared to -5.11° in the sRSA group ($p < 0.0005$). Slightly more patients in the aRSA group (62.1%) had at least 1 comorbidity compared to the sRSA group (55.6%). There was no significant difference between groups in average improvement of ASES, UCLA, and SPADI scores ($p = 0.288$, $p = 0.256$, $p = 0.220$, respectively). Additionally, there was no significant difference between aRSA and sRSA groups in average improvement of active ROM of abduction, forward elevation, or external rotation ($p = 0.142$, $p = 0.248$, $p = 0.385$ respectively). No significant difference was found in intraoperative blood loss, hospital stay length, or postoperative complications ($p = 0.14$, $p = 0.67$, $p = 0.23$, respectively).

CONCLUSIONS: The decision between augmented glenoid baseplate vs. standard RSA for severe glenoid bone loss is still unanswered for surgeons. While augmented glenoid baseplates restore bone loss and soft tissue tensioning, concern is over tensioning or over tightening. Our results did not see a significant impact on function or stability for an augmented baseplate compared to standard in these RSA cases. Further research is needed to help guide surgeons on when to select the augmented baseplate and who the optimal patients are for these innovative implant options in RSA.

Paper 200

Subscapularis Integrity and Patient Outcomes after Total Shoulder Arthroplasty: What is the Influence of Sling Immobilization?

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BACKGROUND: Maintaining subscapularis integrity may be a significant variable in optimizing outcomes of total shoulder arthroplasty (TSA). Multiple factors have been reported in orthopedic literature to cause subscapularis failure. Most surgeons follow a protocol that calls for some period of immobilization. However, time to mobilization and rehabilitation is still a point of discussion, as no consensus currently exists. Our study aimed to compare postoperative outcomes of patients who followed a traditional immobilization protocol to those who underwent rapid mobilization.

METHODS: A single-blinded, randomized control trial (RCT) was conducted between December 2015 and May 2018. Patients were prospectively enrolled and randomized using a 1:1 allocation into two groups: prolonged immobilization for at least 4 weeks or rapid mobilization within 1 week. All cases were performed by a single, fellowship-trained orthopedic surgeon with standard pre- and intraoperative protocols. Metallic markers were used to mark the subscapularis tendon. Postoperatively, patients were revealed to their randomization assignment and provided detailed instructions on when to begin mobilization. Patient-reported outcome scores, physical exam, and radiologic assessments were evaluated at specific follow-up time points: preoperatively and 6 weeks, 3 months, 6 months, 12 months, and 32 months postoperatively. Our primary outcome was clinical and radiographic subscapularis failure.

RESULTS: 41 patients were enrolled and 38 patients (19 in each arm) were included in the final analysis. No statistically significant difference (all p-values >0.05) was seen between the prolonged immobilization and rapid mobilization groups for American Shoulder and Elbow Surgeons Shoulder Score, Function Score, Visual Analog Score, Simple Shoulder Test Score, and Short-Form Surveys (SF12 MCS and SF12 PCS) at any time point. When evaluating active forward flexion and external rotation, there also was no statistically significant difference between the two groups at any time point (all p-values >0.05).

CONCLUSION: Our RCT compared currently accepted protocols to immobilize for 4-6 weeks following subscapularis repair to early mobilization within 1 week and found no statistical and clinical difference in outcomes. This may support a model for early, rapid mobilization following TSA, which can facilitate rehabilitation and return to desired activities of daily living. This seems to be in line with recent literature evaluating immobilization after rotator cuff repair in a non-arthroplasty setting.

Paper 201

**Restoration of the Native Humeral Anatomy During Anatomic Total Shoulder Arthroplasty:
A Radiographic Comparison of Intramedullary Vs. Extramedullary Resection**

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INTRODUCTION: During anatomic total shoulder arthroplasty (aTSA), the humeral head can be resected using extramedullary (EM) or intramedullary (IM) resection. Clinical outcomes following aTSA are partially predicated on the restoration of the native humeral anatomy. To date, no studies have determined which method of humeral head resection is superior in restoring native humeral anatomy. Therefore, the purpose of this study was to determine whether EM or IM resection was superior in restoring normal anatomy during aTSA with stemless implants.

METHODS: A review of all patients who underwent aTSA using the stemless Tornier Simpliciti™ Shoulder System (Wright Medical Group, Memphis, TN) at two academic institutions by two separate surgeons between January 2017 and June 2020 was performed. One surgeon at one institution performed aTSA with IM resection while the other did so with EM resection. Patients were excluded if they underwent aTSA for an indication other than glenohumeral osteoarthritis, if they received a short-stem or standard-stem implant, and if they lacked adequate preoperative and postoperative Grashey radiographs. One hundred eleven patients across both institutions (51 IM, 60 EM) were included for final radiographic assessment. The center of rotation (COR), humeral head height (HH), and neck-shaft angle (NSA) were measured on preoperative and postoperative Grashey radiographs for each patient in both groups using previously validated methods. The differences between the preoperative and postoperative measurements were calculated for each parameter and patients were subsequently classified as either having acceptable restoration or unacceptable restoration of their native anatomy.

RESULTS: The mean differences in COR, HH, and NSA between the EM and IM cohorts was 2.3 vs. 1.2 mm, 4.4 mm vs. 1.7 mm, and 133.8° vs. 134.4°, respectively. IM resection had the greatest acceptable restoration of COR (90.2% IM vs. 70% EM, $p = 0.009$), HH (96.1% IM vs. 63.3% EM, $p < 0.001$), and NSA (96.1% IM vs. 78.3% EM, $p = 0.006$) relative to EM resection.

CONCLUSION: Restoration of the native humeral anatomy following aTSA occurred at significantly higher rates when using IM resection vs. EM resection of the humeral head. In addition, EM resection places the humeral component into a varus position relative to IM resection.

Breakout Session #14 (Shoulder Arthroplasty)
Saturday, April 09, 2022

Paper 202

Efficacy of Combinational Therapy using Blue Light and Benzoyl Peroxide In Reducing Cutibacterium Acnes Bioburden at the Deltopectoral Interval: A Randomized Controlled Trial

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BACKGROUND: Cutibacterium acnes (C. acnes) is a common pathogen associated with infection following shoulder surgery. Blue light therapy (BLT), wavelength of 405nm-470 nanometers, is a Food & Drug Administration (FDA) approved modality previously described in the dermatology literature as an effective antimicrobial agent against C. acnes. The purpose of this study is to compare the efficacy BLT and BPO in eradicating C. acnes at the deltopectoral interval (DPI), measured by positive, quantitative cultures.

METHODS: Male volunteers at least 18 years of age were randomized to one of three treatment groups: BPO, BLT, and BPO followed by BLT. Contralateral shoulders served as matched controls for each volunteer. Volunteers randomized to BPO applied the gel for a total of five treatments, which was followed by a skin swab culture taken from the DPI. For BLT group, the BLT device was centered over the DPI, and a single 23-minute treatment was administered at an estimated irradiance of 40 mW/cm² (radiant exposure 55.2 J/cm²). For BPO+BLT group, volunteers received both treatments as described above. After treatment, control and treatment shoulders were prepped with Chlorhexidine (CHX) and cultures were taken from each shoulder. Cultures were analyzed for anaerobic quantitative growth with polymerase chain reaction confirmation of presumptive C. acnes colonies.

RESULTS: Sixty male volunteers, 20 per group, were enrolled and completed all study activities. On quantitative analysis, BPO group and BPO+BLT group had significantly less growth of C. acnes compared to BLT group after treatment, but prior to CHX (p<0.05). No differences were seen between BPO group and BPO+BLT group for quantity of growth prior to CHX (p = 0.344). Following CHX administration BPO and BPO+BLT groups both had significantly fewer positive cultures (Odds Ratio 0.03 and 0.29, respectively) and less quantity of growth than their control arms (p<0.05). This was not seen in BLT group. for quantitative between group analysis, despite less overall growth, no significant synergistic effects were seen in the BPO+BLT group compared to BPO only (p = 0.688). There was no difference in side effects between groups.

CONCLUSION: Combination topical BPO and CHX is effective at eliminating C. acnes in most cases. BLT alone demonstrated ineffective antimicrobial properties against C. acnes, at the radiant exposure administered in this study. Combining BPO and BLT did not lead to significant synergistic antimicrobial effects. More work is needed to determine if BLT at higher radiant exposures or serial treatments results in bactericidal effects to C. acnes in vivo.

Paper 203

Effect of Reverse Total Shoulder Arthroplasty (rTSA) on Scapulothoracic Positioning

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BACKGROUND: While rTSA is commonly performed for multiple indications such as glenohumeral osteoarthritis and rotator cuff arthropathy, outcomes of rTSA depend heavily on maximizing postoperative range of motion through rehabilitation. Biomechanically, the center of rotation is moved medial and distal, which improves the efficiency of the deltoid by increasing its lever arm. Given these biomechanical changes, the scapulothoracic joint may be affected by the procedure and may provide a postoperative rehabilitation target. However, there is a lack of sufficient literature on the effects of rTSA on the scapulothoracic joint. The purpose of this study is to evaluate the changes in the scapulothoracic angles after rTSA.

METHODS: We retrospectively analyzed the unilateral anteroposterior shoulder radiographs of 65 patients undergoing rTSA. The scapulothoracic (STA) and scapulohumeral (SHA) angles were measured and compared preoperatively and then postoperatively at 1 month and 3 months. Descriptive statistical analysis and paired t-tests were performed to evaluate the differences between angles over 3 months of follow-up.

RESULTS: The records of 43 females (60 ± 11.51 years old) and 22 males (65 ± 6.05 years old) were queried. The average preoperative values for STA and SHA were 46.00 ± 11.30 and 49.80 ± 13.12 degrees, respectively. There was a statistically significant difference between the SHA obtained preoperatively and the SHA obtained at 1 month postoperatively (54.94 ± 11.00 , $p = 0.001$). However, our analysis also found that the SHA obtained 3 months postoperatively (52.78 ± 12.66) was not significantly different from the SHA obtained preoperatively ($p = 0.06$) or the SHA obtained at 1 month postoperatively ($p = 0.06$). No statistical differences were found between the STA values obtained preoperatively and at 1 month ($p = 0.11$), and 3 months ($p = 0.97$) postoperatively.

CONCLUSION: While the SHA is significantly different after one month postoperatively, our results show that the SHA normalizes after three months. These results may be evidence of a temporary alteration in scapular kinematics postoperatively. The impact of these changes on deltoid or scapulothoracic muscle activation need to be further investigated.

Breakout Session #14 (Shoulder Arthroplasty)
Saturday, April 09, 2022

Paper 204

Trends in Shoulder Arthroplasty during the COVID-19 era: Increased Proportion of Outpatient Cases with Decrease in 90-day Readmissions

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BACKGROUND: The COVID-19 pandemic has placed increased burden on healthcare resources, with hospitals cancelling most elective surgical cases during the initial period of the pandemic. There has also been an increased interest in performing outpatient shoulder arthroplasty in a safe and efficient manner. The purpose of this study is to investigate trends in total shoulder arthroplasty during the COVID-19 era with respect to outpatient surgery. We also sought to evaluate trends in postoperative complications during the COVID-19 era.

METHODS: A retrospective chart review was performed of all primary anatomic and reverse total shoulder arthroplasties at our health institution over a three-year period (January 2018 – January 2021). Only arthroplasties done for primary osteoarthritis or rotator cuff arthropathy were included. All cases done prior to March 2020 were considered the “pre-COVID era” cohort. All cases after March 2020 were in the “COVID-19 era” cohort. Patient demographic and medical comorbidities were also collected to appropriately match patients from the two cohorts. Outcomes measured included patient encounter (outpatient vs. inpatient), length of stay, 90-day surgery-related readmission, 90-day surgery-related emergency room (ER) visit, 90-day venous thromboembolism (VTE), and any other postoperative complications.

RESULTS: 567 total shoulder arthroplasties met the inclusion criteria. There were 270 shoulder arthroplasty cases during the COVID-19 era, and 297 cases during the pre-COVID era. There were no significant differences in demographic or medical comorbidities between the two examined cohorts. There was a significantly higher proportion of outpatient cases during the COVID-19 era (31.9% vs. 4.5%, $p < 0.0001$). Average length of stay was significantly reduced in the COVID-19 era (0.81 vs. 1.45 days, $p < 0.0001$). There was no statistically significant difference in the type of arthroplasty performed (anatomic vs. reverse) between the two cohorts. There was a significant decrease in 90-day readmissions and insignificant decrease in 90-day ER visits, 90-day VTE, and 90-day perioperative complications.

CONCLUSION: We found a significant increase in the number of outpatient shoulder arthroplasty cases being done at our health institution during the COVID-19 era. This increase in outpatient cases was associated with a significant reduction in average hospital length of stay and significant decrease in 90-day readmissions. The data suggest that outpatient total shoulder arthroplasty can be performed in a safe and efficient manner in the appropriate patient cohort.

Paper 205

Ambulatory Outpatient Shoulder Arthroplasty 2-Year Outcomes and Complications: A Case-Control Cohort Study

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BACKGROUND: Outpatient total shoulder arthroplasty (TSA) and reverse total shoulder arthroplasty (RTSA) have been shown to be safe and cost-effective alternatives to inpatient hospitalization when performed with appropriate patient selection. We hypothesized that patients that undergo ambulatory outpatient shoulder arthroplasty (SA) would have similar two-year outcomes and complication rates compared to a cohort of healthy patients performed inpatient only due to insurance requirements.

METHODS: All primary TSA and RTSA performed outpatient (OP) with same day discharge at a free-standing ambulatory surgery center between January 2014 and January 2018 were identified and included. A comparison group of inpatients (IP) was selected using a standardized medical selection algorithm and reviewing clinical information to identify procedures performed inpatient only due to insurance requirements. Range of motion (FE: forward elevation, IR: internal Rotation, ER: External Rotation) and outcome scores (VAS, SANE, ASES) were obtained preoperatively, at year 1 (Y1), and year 2 (Y2). Clinical documentation was reviewed for complications, re-operations, revisions, 30-day re-admissions, and inpatient length of stay (LOS) >1 day.

RESULTS: The cohort consisted of 71 OP (44 TSA, 27 RTSA) and 114 IP (41 TSA, 73 RTSA). OP were younger (OP: 58.55 ± 6.95 years, IP: 64.49 ± 5.82 years; $p = <0.001$) and more likely to have undergone TSA ($p = 0.001$). Both groups had similar BMI ($p = 0.556$), diagnosis ($p = 0.337$), ASA score ($p = 0.483$), preop ROM and outcome scores. OP had significantly better Y2 FE ($p = 0.031$), Y1 VAS ($p = 0.026$), and Y1 ASES ($p = 0.007$) based on Student's t-test. Linear regression analysis adjusted for covariates found OP had significant effects on Y1 FE ($p = 0.019$), Y2 FE ($p = 0.021$), Y1 VAS ($p = 0.005$), Y2 VAS ($p = 0.018$), Y2 SANE ($p = 0.040$), Y1 ASES ($p = 0.012$), and Y2 ASES ($p = 0.036$). OP and IP had similar rates of complications (12.7% vs. 17.5%, $p = 0.498$), re-operations (7.0% vs. 6.1%, $p = 0.810$), revisions (2.8% vs. 3.5%, $p = 0.797$), and re-admission (1.4% vs. 2.6%, $p = 0.580$), respectively. There were 5 patients performed IP who required LOS >1 day. The most common complications were rotator cuff tear, arthrofibrosis, acromial stress fracture, and inadequate pain control.

CONCLUSION: Ambulatory outpatient TSA and RTSA is associated with similar short-term outcomes and complication rates when compared to a cohort of healthy inpatients. As the demand for SA rises, ambulatory outpatient procedures can be considered a safe and cost-effective alternative to inpatient hospitalization when performed with appropriate patient selection.

Breakout Session #14 (Shoulder Arthroplasty)
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Paper 206

Local Infiltration Analgesia Vs. Interscalene Block for Postoperative Pain Management Following Total Shoulder Arthroplasty: A Randomized Clinical Trial

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INTRODUCTION: Pain management following total shoulder arthroplasty (TSA) is an important factor in determining patient outcomes and satisfaction. Interscalene block has been used successfully to minimize pain in the acute postoperative period. While shown to be effective, interscalene block has known complications. Local infiltration analgesia (LIA) has been used in other joint arthroplasties as an alternative to peripheral nerve block, but little is known about the role of periarticular LIA in TSA. The purpose of this study is to determine if LIA leads to similar postoperative pain scores and opiate consumption compared to interscalene block following TSA.

METHODS: Patients undergoing primary anatomic or reverse TSA were prospectively randomized into two groups: The block group received standard interscalene block preoperatively, whereas the local group received LIA cocktail injection into the deltoid and pectoralis major muscles, fascia, and subcutaneous tissue intraoperatively. The LIA cocktail consisted of 40mL of 0.5% ropivacaine, 0.1mL of 1mg/mL epinephrine, 1 mL of 30mg/mL ketorolac, and 59mL of normal saline. Postoperatively, data for visual analog pain scale (VAS) and opiate consumption in morphine milligram equivalents (MME) were collected. Data were statistically compared between groups and across time points. Complication rates were also compared between groups.

RESULTS: The study is currently in progress and included a total of 53 patients (16 females) for analysis, which is 71% of our enrollment goal (74 patients in total). Of these, 26 (49%) underwent anatomic TSA and 27 (51%) reverse TSA. The block group had 28 patients, and the local group had 25 patients. Patient demographics were not significantly different between groups ($p > 0.05$). There was no significant difference in VAS pain scores at any time point between groups ($p > 0.05$), except for the 8-hour time point, where the block group had a significantly lower VAS pain score than the local group ($p = 0.04$, 1.9 and 3.6, respectively). There was no significant difference found in opiate consumption between the groups at any time point ($p > 0.05$). One patient in the local group sustained a dislocation of his reverse arthroplasty in the first 2 weeks due to noncompliance with postoperative protocols. Otherwise, no other complications were found in either group.

DISCUSSION: LIA provided comparable pain control to interscalene block following TSA with no increased complications. LIA can be an effective and inexpensive alternative to interscalene block.

Breakout Session #14 (Shoulder Arthroplasty)
Saturday, April 09, 2022

Paper 207

Reverse Shoulder Arthroplasty for the Treatment of Primary Glenohumeral Arthritis Among American Board of Orthopaedic Surgery Part II Candidates, 2008-2019

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BACKGROUND: Despite advances in implant design, treatment for advanced glenohumeral osteoarthritis (GHOA) remains limited and definitive surgical management includes anatomic total shoulder arthroplasty (TSA), reverse total shoulder arthroplasty (RSA), and hemiarthroplasty. Shoulder arthroplasty in the United States has substantially increased in recent years. Surgical indications for RSA have expanded, but the contribution for treatment of primary GHOA has not been determined. The purpose was to examine trends in arthroplasty use (TSA, RSA, and hemiarthroplasty) for primary GHOA among American Board of Orthopaedic Surgeons (ABOS) Part II examinees, and to identify patterns based on geographic region or fellowship training.

METHODS: ABOS Part II examinees with at least one shoulder arthroplasty in the examination years 2008-2019 were collected. Hemiarthroplasty, TSA, and RSA performed from 2007-2018 for an isolated diagnosis of primary GHOA were included. Arthroplasty for fracture, infection, tumor, rotator cuff arthropathy or tear, revision, and non-arthroplasty procedures were excluded. Proportion and volume of cases were evaluated, with sub-analyses of geographic region and fellowship training. Univariate logistic regression determined statistical significance ($p < 0.05$).

RESULTS: A total of 946,946 cases from 8,609 ABOS Part II examinees were submitted, with 8,733 shoulder arthroplasties performed. Overall, 3,923 arthroplasties for primary GHOA were included. TSA was used in 50.9% of cases. RSA performed for primary GHOA has increased over time, with RSA surpassing TSA as the most common procedure over the last four years ($p < 0.001$). Hemiarthroplasty is less common. TSA and RSA were performed in similar proportions across regions, with the largest volume in the Midwest. Most procedures (91.5%) were completed by surgeons in sports medicine, shoulder/elbow, and those completing multiple fellowships. RSA performed for primary GHOA by sports medicine and shoulder/elbow surgeons increased approximately 1,100% and 800% (respectively) since 2008 ($p < 0.001$).

DISCUSSION: Utilization of RSA for treatment of primary GHOA by ABOS Part II examinees has increased significantly over the past twelve years. Among recently trained surgeons, RSA surpassed TSA as the most common arthroplasty for treating primary GHOA. Examining early-career surgical practices allows for consideration of training influence in treating GHOA. As volume of shoulder arthroplasty increases, trends and procedure volume have implications for clinical practice and patient outcomes.

Breakout Session #14 (Shoulder Arthroplasty)
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Paper 208

The Influence of Diabetes Mellitus on Outcomes in Shoulder Arthroplasty

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INTRODUCTION: The prevalence of diabetes mellitus (DM) in the United States is approximately 10% and increasing, especially among the elderly. Patients with DM have an increased risk of cardiac disease, hypertension, vascular pathology, and infection. As a result of these comorbidities and other factors, peri- and postoperative complications may occur more in this patient population. The current literature exploring a link between DM and shoulder arthroplasty outcomes and complications is lacking. The purpose of this study was to investigate both the consequences of DM in shoulder arthroplasty patients using a relatively large cohort and a dose-response relationship between HbA1c and outcomes.

METHODS: This retrospective cohort study began with search of the electronic medical record at our institution between 2010 and 2019 identified 812 shoulders which had undergone either primary total or reverse shoulder arthroplasty. Charts were excluded if they had less than one year of follow-up or incomplete data. During chart review, diabetes status and the most proximal preoperative HbA1c were recorded to divide charts into a diabetic and a nondiabetic group. The primary outcome measures were range of motion and VAS pain score. Secondary outcomes were ER and hospital readmission rates, intra- and postoperative complications and infection.

RESULTS: After applying exclusion criteria, 184 shoulders were excluded, leaving 628 in our cohort. Of these, 165 had a DM diagnosis and 463 did not. Both groups experienced significant improvements in each range of motion measurement and VAS score, however, these improvements were not significantly different between the two groups. Any-cause hospital and emergency department readmission were significantly higher in the DM group compared to the non-DM group (20.1% vs. 7.5% and 73% vs. 59%, respectively, $p < 0.001$). Furthermore, we found no significant correlation between preoperative HbA1c and complications, postoperative improvements, complications, or readmission rates.

CONCLUSION: In the setting of shoulder arthroplasty, diabetic patients may benefit significantly from the operation. However, this cohort also displayed a higher risk of emergency department and hospital readmission, postoperatively. Furthermore, we failed to show a dose-response relationship between HbA1c and outcomes.

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Paper 209

Shoulder Arthroplasty for Patients with A History of Convulsive Seizures is Safe

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INTRODUCTION: The safety of shoulder arthroplasty for patients with a history of convulsive seizures is unknown. Concerns include glenoid bone stock, soft tissue laxity, anti-epileptic induced osteopenia, and the consequences of postoperative seizures. We sought to compare outcomes of shoulder arthroplasty in patients with and without a history of convulsive seizures.

METHODS: Between 2000-2017, 56 patients with a history of convulsive seizures who underwent primary shoulder arthroplasty were identified. An equal number underwent anatomic (28 shoulders) and reverse (28 shoulders) total shoulder arthroplasty. The average age was 61.8 (\pm 14.6), and 51.8% (29) were female. Surgical indications included primary glenohumeral arthritis (n = 28, 50%), trauma, both acute (n = 4, 7%) and chronic (n = 11, 20%), cuff tear arthropathy (n = 8, 14%), avascular necrosis AVN (n = 6, 10.5%), congenital dysplasia (n = 2, 3.5%), and malignancy (n = 1, 1.8%), with some patients having multiple diagnoses. This cohort was matched 2:1 to patients with similar surgical and demographic characteristics with no history of seizures. Implant survival, reoperation rates, range of motion, American Shoulder and Elbow Surgeons (ASES) patient reported outcome score, and radiographic outcomes were analyzed.

RESULTS: Reoperation rates were equivalent (p = 0.89) with 3 reoperations (5.4%) in the seizure cohort and 7 (6.3%) in the control cohort. Implant revision rates were also similar. Five-year reoperation Kaplan-Meier survival estimates were 97.8% (91.1 – 100.0) in the seizure cohort and 94.2% (89.0 - 99.6) in the control cohort. Postoperatively, 23 patients (39.3%) had at least 1 seizure but there were no resultant dislocations. One seizure related complication resulted in anterior subluxation due to subscapularis failure, but required no reoperation. In the control cohort, 3 prosthetic dislocations were observed. Range of motion and patient reported outcomes were similar (p = 0.51, p = 0.93). The average ASES scores were 75.2 and 74.8 in the seizure and non-seizure cohorts respectively. Most recent radiographs of the seizure cohort were reviewed by a panel of fellowship-trained Shoulder and Elbow surgeons. Incidence of heterotopic ossification (11%), incomplete lucencies around the glenoid base plate (9%), subscapularis failure (4%), component loosening (3.5%), and scapular notching (2%) were noted.

DISCUSSION: Reoperation rates and implant survival following shoulder arthroplasty were similar with and without a history of convulsive seizures. Post-arthroplasty seizures occurred in a notable number of patients but caused no major complications or reoperations. While preoperative seizure control remains critical, our data suggests that a convulsive seizure disorder does not increase complications or implant failure risk following shoulder arthroplasty.

Paper 210

What are the Risk Factors Associated with Limited Musculoskeletal Health Literacy in Shoulder Arthroplasty Patients?

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INTRODUCTION: Low health literacy is both pervasive in the United States and a substantial barrier to satisfactory patient care and the appropriate utilization of healthcare resources. Musculoskeletal literacy has been demonstrated to be even more widespread than low general health literacy. The purpose of this study was to evaluate the factors that contribute to limited musculoskeletal literacy in patients who undergo shoulder arthroplasty.

METHODS: Ninety patients undergoing shoulder replacement surgery completed demographics and Literacy in Musculoskeletal Problems (LiMP) surveys. 30 patients completed the surveys preoperatively, 30 completed them within 90 days of surgery, and 30 completed them more than 90 days after surgery. Scores of less than 6 were considered indicative of limited musculoskeletal literacy.

RESULTS: The overall percentage of participants with limited musculoskeletal literacy was 38.8%. Multivariable logistic regression analysis with multiple imputation modeling demonstrated a significant positive relationship between patient income and adequate LiMP scores ($p = 0.009$) with an odds ratio of 1.15 (CI: 1.04; 1.28) while level of education ($p = 0.173$) and patient ethnicity ($p = 0.830$) among other patient characteristics did not have a significant relationship with LiMP scores.

DISCUSSION: Existing literature has already established that low health literacy is tied to poor patient outcomes. In patients undergoing shoulder replacement surgery, low income was the only variable found to be predictive of limited musculoskeletal health literacy scores. Therefore, when discussing the risks and benefits of shoulder arthroplasty, orthopedic surgeons should be cognizant of the possibility that any given patient may not meet the threshold of adequate musculoskeletal literacy.

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Paper 211

Undergoing an Arthroscopic Procedure prior to shoulder arthroplasty is associated with a greater risk of prosthetic shoulder infection

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PURPOSE: To utilize a national all-payer claims dataset to understand whether a history of a prior shoulder arthroscopy is associated with adverse outcomes and/or complications following the index shoulder arthroplasty itself.

METHODS: The Symphony integrated DataVerse, an all-payer claims database, was utilized to identify patients undergoing primary shoulder arthroplasty (hemiarthroplasty, anatomic total shoulder arthroplasty, or reverse total shoulder arthroplasty) between 2017 to 2018. Current Procedural Terminology codes were used to identify patients who had undergone a shoulder arthroscopic procedure on the ipsilateral side within two years prior to the arthroplasty. Multivariate logistic regression analyses were used to assess whether prior shoulder arthroscopy was associated with higher risks of wound complications, postoperative stiffness, mechanical complications, prosthetic joint infection, revision surgery, and readmissions within 90 days of the arthroplasty.

RESULTS: A total of 19,429 patients were included, out of which 837 (4.3%) had undergone shoulder arthroscopy within 2 years prior to the arthroplasty. Prior shoulder arthroscopy was associated with a significantly higher risk of prosthetic joint infection (OR 2.74 [95% 1.51-4.69]; $p < 0.001$) within 90 days of the arthroplasty. The greatest risk of prosthetic joint infection was associated with arthroscopies that took place within 3 months prior the undergoing the arthroplasty (OR 5.32 [95% 1.42-15.14]; $p = 0.005$).

CONCLUSION: Undergoing an arthroscopic procedure of the ipsilateral shoulder prior to undergoing an arthroplasty was associated with greater risk of prosthetic joint infection. Furthermore, it appears that patients who received arthroscopy within the three months prior to arthroplasty, had the highest risk of prosthetic joint infections. Physicians should not only anticipate possible inferior outcomes in patients who have had prior arthroscopy, but also consider delaying the arthroplasty by at least three months after the arthroscopy to mitigate the risks of experiencing this costly adverse event.

Paper 212

Cost Analysis and Complication Rate of Massive Irreparable Rotator Cuff Tear Treatment: Comparisons of Superior Capsular Reconstruction, Lower Trapezius Tendon Transfers, and Reverse Shoulder Arthroplasty

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INTRODUCTION: Irreparable rotator cuff tears (IRCT) pose treatment challenges both clinically and financially. As cost effectiveness initiatives are prioritized, value-based healthcare delivery models are becoming increasingly common. The purpose of this study was to perform a comprehensive analysis of the cost, complications, and readmission rates of three common surgical treatment options for IRCTs: superior capsular reconstruction (SCR), arthroscopically-assisted lower trapezius tendon transfer (LTT), and reverse shoulder arthroplasty (RSA).

METHODS: Between 2018 and 2020, 155 patients who underwent shoulder surgery at a single institution for IRCT with minimal to no arthritis were identified. Procedures performed included 20 SCRs, 47 LTTs, and 88 RSAs. A cost analysis was designed to include a period of 60 days preoperatively, the index surgical hospitalization, and 90 days postoperatively, including costs of any readmission or reoperation.

RESULTS: Mean standardized costs were as follows: preoperative evaluation SCR \$507, LTT \$507, and RSA \$730; index surgical hospitalization SCR \$19,675, LTT \$15,722, and RSA \$16,077; and postoperative care SCR \$655, LTT \$686, and RSA \$404. Significant differences were observed in the index surgical costs ($P < .001$), with SCR incurring an additional average cost of \$3,953 and \$3,598 when compared to LTT and RSA, respectively. The 90-day complication, reoperation, and readmission rates were 0%, 0%, and 0% in the SCR group; 2.1%, 0%, and 0% in the LTT group; 3.4%, 0%, and 1.1% in the RSA group, respectively. With the numbers available, differences among the 3 surgical procedures with respect to complication ($P = .223$), reoperation ($P = .999$), and readmission rates ($P = .568$) did not reach statistical significance.

CONCLUSION: The mean standardized costs for treatment of three common IRCT procedures inclusive of 60-day workup and 90-day postoperative recovery were \$16,915, \$17,210, and \$20,837 for LTT, RSA (average added cost \$295), and SCR (average added cost \$3,922), respectively. This information may provide surgeons and institutions with cost-related information that will become increasingly relevant with the expansion of value-based surgical reimbursements.

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Paper 213

Patients' Perceptions and Utilization of Physical Therapy after Shoulder Surgery

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BACKGROUND: Formal Physical Therapy (PT) traditionally has been a critical part of postoperative recovery after orthopedic surgery but due to recent cost containment efforts in health care and bundle payments, the coverage for formal PT has become limited. As access to physical therapy is threatened, alternatives to formal PT have been proposed, including telerehabilitation, internet-based PT, and even home-based physician-guided PT. The purpose of this study was to understand patient perceptions of PT, the benefits, perception of improvements, access to PT, and alternative forms of PT after shoulder surgery.

METHODS: This cross-sectional study used an anonymous survey of 80 orthopedic surgery shoulder patients at a single institution. The variables collected included demographics, access to PT, number of PT sessions, insurance, copayment, patient perceptions of improvement, and their opinion about internet-based PT (IBPT). Answers were designed using Likert-scale or multiple-choice questions. Descriptive statistics were used to report survey data. Analyses were performed based on demographic variables using independent t-test, chi-square tests, and an analysis of variance (ANOVA).

RESULTS: Patients attended an average of 16 ± 13.8 PT sessions with a perceived $65\% \pm 32.2$ average improvement attributed to their sessions. The average copay was $\$18 \pm 20.8$ per session, which 56.14% agreed or strongly agreed that it was reasonable. Patients reported $65.0\% \pm 32.2$ perceived the improvement they saw in their condition attributable to their physical therapy sessions and 94.8% of patients agreed or strongly agreed their therapist took the time to educate them. When asked about internet-based PT (IBPT), 52.5% disagreed that successful PT could be achieved by IBPT. There were also 68.6% of patients who responded that they would not consider using IBPT even after a few in-person sessions.

CONCLUSION: Patients have a positive perception of their therapist, cost, number of sessions, and utility of PT to impact their improvements following orthopedic shoulder surgery. As cost containment remains a priority, it seems that for internet-based PT to be a viable alternative this will require integration and close engagement of a physical therapist given patient's perception and values on the impact of formal PT.

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Paper 214

Better Outcomes? Rotator Cuff Repair vs. Reverse Shoulder Arthroplasty for Massive Rotator Cuff Tears

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INTRODUCTION: Despite advances in surgical technology with rotator cuff repairs, there is a high re-tear rate for large and massive rotator cuff tears (RCT), up to 90%. An alternate treatment option more recently offered to elderly patients is reverse shoulder arthroplasty (RSA) for massive RCT. The purpose of this study was to compare outcomes, opioid usage, and pain scores for patients treated with RCR vs. RSA for massive RCT.

METHODS: A retrospective review of 400 patients in a shoulder arthroplasty registry was performed to identify 48 patients with large or massive RCT treated with RSA vs. RCR. All patients were treated by two fellowship-trained shoulder surgeons at a single institution. Preoperative and postoperative range of motion, opioid usage, and outcomes scores such as American Shoulder and Elbow Surgeons (ASES) scores, Penn (PSS) scores, Constant scores (CS), and Subjective Shoulder Value (SSV) were collected. Demographic variables and outcomes scores at preoperative assessment and postoperatively at 6 weeks, 3 months, and 6-12 months were compared using t-tests and multivariable regression modeling.

RESULTS: There were 30 males and 18 females with average age of 60.7 years old for the RCR and 66.4 for the RSA ($p = 0.016$) and BMI of 28.9 and 30.4 for each group respectively. At baseline there were no differences between groups for ASES, PSS pain, CS, and SSV ($p \geq 0.05$). At 6 weeks, the average PSS and ASES function and CS scores for RSA group were significantly higher compared to RCR group ($p = 0.0001$, $p = 0.003$, $p = 0.005$). All patient reported outcomes at 3 and 6 months postoperatively were not significantly different between groups. At final follow-up, abduction and internal rotation along with the delta score for passive forward flexion were significantly higher for RCR. No significant differences in complication rates were seen between groups.

CONCLUSION: Our results demonstrated that both RCR and RSA showed significant improvements in all pain and functional scores. The RSA group showed better initial recovery with significant difference seen at six weeks postoperative and the RCR group having slightly better final ROM. RSA is comparable to RCR, suggesting both options are good solutions for treatment of massive tears. However, surgeons should be aware of the tradeoffs associated with each option. Further studies are needed to examine long-term function, complications, re-tear rates, and cost effectiveness in these patients.

Paper 215

Sensitivity of Quantitative Measures of Soft Tissue Quality in Patients Undergoing Reverse Shoulder Arthroplasty

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BACKGROUND: Reverse Shoulder Arthroplasty (RSA) patients present with a range of soft-tissue quality. An established method of evaluating CT scans in the scapular plane, originally for assessing glenoid version, is adapted for rotator cuff (RC) soft tissue assessment. However, manual identification of scapular plane orientation and muscle bellies may introduce variability. It is unknown what margin of reference offset significantly impacts RC quality measures. The study purpose was: (1) to assess the sensitivity of variation in scapular reference orientation on RC quality measures, and (2) to determine if multiplanar adjustment reduces sensitivity to reference orientation.

METHODS: Supraspinatus, subscapularis, infraspinatus/teres minor muscle quality and cross-sectional area (CSA) of five subjects undergoing RSA was assessed using 3D axial CT scans. The scans were objectively aligned to a reference scapular plane orientation from the scan orientation and average values from 2 slices were used (Chalmers et al., 2017). Sensitivity analyses evaluated effects of $\pm 5^\circ$ offsets from the reference orientation on RC CSA, %muscle occupation, and qualitative atrophy (Warner grade). Fatty infiltration (Goutallier classification) and %fat occupation (Hounsfield units) were assessed. Paired T-tests with Bonferroni correction compared these measures using standard axial correction vs. using an additional coronal plane correction designed to facilitate inferior angle capture.

RESULTS: Significantly less supraspinatus fat occupation was measured for -5° ($p = 0.020$) from baseline reorientation. Statistically significant differences were not observed for $\pm 5^\circ$ offset on RC CSA. Offsets of $\pm 5^\circ$ did not significantly influence %atrophy or visual classification for any RC muscles. Utilizing a new two plane correction factor significantly affected subscapularis CSA ($p = 0.003$), but did not affect infraspinatus/teres minor or supraspinatus CSA, or %muscle occupation.

DISCUSSION: Current methodology of axial-only correction, developed for glenoid evaluation, may be improved for shoulder soft-tissue analysis. The sensitivity ($< \pm 5^\circ$) observed for supraspinatus fatty infiltration highlights the importance of accurate measurements, especially for surgical planning and patient-specific modeling. Known limitations of qualitative RC infiltration assessment necessitate greater reliance on quantitative values. Assessment is important since supraspinatus deficiency due to fatty infiltration may require greater deltoid demands to initiate torque during abduction post-RSA, which may impair functional activities. This foundational study establishes that a standardized imaging protocol may necessitate an additional correction factor and provide an easier method for RC condition evaluation to assist with clinical decision making such as supraspinatus preservation in RSA.

Paper 216

An Analysis of Inclination Correction by Reaming in a Consecutive, Single-Surgeon Series of 3D Planned Reverse Total Arthroplasties

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BACKGROUND: The optimal inclination of the glenoid component in reverse total shoulder arthroplasty (rTSA) is unknown; however, an inferiorly tilted or neutral glenoid baseplate typically requires corrective reaming, structural grafting, or an augmented baseplate. Significant corrective reaming of the inferior glenoid has been theorized to result in medialization, a shortened scapular neck, and impingement. Few reports have described the relationship between the amount of reaming and factors such as degrees of inclination correction, rTSA, and patient demographics. The purpose of the current study was to characterize these effects in a large series of rTSA cases that were 3D planned and executed with a patient specific guide.

METHODS: A retrospective review of rTSA cases planned by a single-surgeon using commercially available 3D CT software program (Virtual Implant Positioning) between 2018 and 2020 was conducted to evaluate the relationship between the 3D virtual reaming depth (mm) required to execute the planned 3D glenoid inclination change along with rTSA indication and patient factors. Cases planned for reconstruction using structural graft (defined as planned backside seating <75%), using a Univers Reverse baseplate, and those with planned glenoid inclination greater than native glenoid inclination were excluded. Pearson's correlation coefficient was calculated to evaluate the relationship between the planned reaming depth and the above factors.

RESULTS: Sixty-three cases met the inclusion criteria in 29 males (46%) and 34 females (54%). The indications for planning of rTSA included 22 cases of rotator cuff arthropathy (35%), 26 cases of massive rotator cuff tears or fracture with no osteoarthritis (41%), and 15 cases of cuff-intact osteoarthritis (24%). The median native 3D inclination was 9 degrees (IQR = 6-13). Seventy percent of cases were planned to an implant inclination of 0 degrees. The median inferior glenoid reamed was 8 mm (IQR = 6-10). Corrective reaming depth was strongly, positively correlated with planned degrees of inclination correction, $r(61) = 0.67$, $p < 0.001$. No significant correlation was found between reaming depth and rTSA indication or any patient factor such as age or sex.

CONCLUSION: Corrective reaming depth of the inferior glenoid in 3D planned rTSA cases is highly correlated with correction of superior glenoid inclination. An average reaming depth of 8 mm in the current series was necessary to achieve an average 9-degree inclination correction.

Breakout Session #14 (Shoulder Arthroplasty)
Saturday, April 09, 2022

Paper 217

The impact of depression and anxiety on shoulder arthroplasty outcomes

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INTRODUCTION: Anxiety and major depressive disorder (MDD) represent the two largest groups of mental disorders in the United States and significantly impair function in those affected. Beyond hallmark symptoms, these disorders have been implicated as risk factors for disease, adverse events, and poor treatment outcomes. However, data concerning the influence of these disorders on shoulder arthroplasty outcomes have been mixed. The purpose of this retrospective cohort study was to evaluate the influence of preoperative diagnosis of anxiety and/or major depression on outcomes following SA, such as range of motion, pain, peri- and postoperative complications, and readmission rates. We hypothesized that patients with preoperative diagnosis of anxiety and/or depression would exhibit inferior outcomes when compared to those without these diseases.

METHODS: The electronic medical record at our institution was queried for all patients who underwent a primary TSA or RSA between the years 2010 and 2019. Patients were excluded for incomplete data, less than one year of follow-up or if they were undergoing a revision surgery. Demographic factors, range of motion, VAS pain score, intra- and postoperative complications, and hospital and emergency department readmission were collected. We compared these outcome measures among patients with a history of depression and/or anxiety and those without.

RESULTS: Initial chart review identified 812 shoulders. Of these, 198 did not meet inclusion criteria, leaving 614 shoulders in our cohort. We identified 143 patients with depression, 109 with anxiety, and 405 without any psychiatric diagnosis. Preoperatively, the depression group had higher pain scores than the nondepressed group (7.3 ± 2.4 vs. 6.7 ± 2.8 , $p = .034$). At final follow-up, the depression and anxiety groups had significantly higher VAS scores compared to those without mental illness (1.94 ± 2.86 vs. 1.28 ± 2.28 , $p = .001$ and 2.1 ± 1.64 vs. 1.28 ± 2.28 , $p = .022$, respectively). While intra- and postoperative complications were similar among the groups, those with depression or anxiety were significantly more likely to be admitted to the ED or hospital following surgery. Average follow-up was $1.3 \pm .8$ years.

CONCLUSION: While depression and anxiety do not seem to affect range of motion or complications, postoperative VAS scores may be heightened in those with these conditions. Additionally, the risk of readmission is higher in this patient cohort.

Paper 218

Periarticular Local Infiltrative Anesthesia after Anterior Cruciate Ligament Reconstruction: A Comparison to Regional Adductor Canal Block with Matched Sub-Analysis

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PURPOSE: To compare postoperative pain and recovery after anterior cruciate ligament reconstruction (ACLR) in patients who received an adductor canal block (ACB) or periarticular local infiltrative anesthesia (LIA).

METHODS: A retrospective review of a prospectively collected ACL registry was performed. Patients underwent ACLR at a single institution between January 2015 and September 2020 and received long-acting local anesthesia with a preoperative ultrasound-guided ACB or peri-articular LIA after surgery. Visual Analog Scale (VAS) pain scores, milligram morphine equivalents (MME) consumed in the post-anesthesia care unit (PACU), and total hospital recovery time were compared. Univariate analysis was used to compare VAS pain and MME totals between overall groups and groups matched for age, sex, BMI, graft type, and meniscal treatment. A p-value < 0.05 indicated statistical significance.

RESULTS: There were 265 knees (253 patients) included (LIA, 157 knees; ACB, 108 knees). Overall, VAS pain scores before hospital discharge (LIA 2.6 ± 1.5 vs. ACB 2.4 ± 1.4 , $p = 0.334$) and total MMEs were similar (LIA 17.6 ± 7.6 vs. ACB 18.5 ± 6.7 (MME), $p = 0.134$). Total time to discharge also did not significantly differ (LIA 137.5 (IQR:116-178) vs. ACB 147 (IQR:123-183) (min), $p = 0.118$). Matched sub-analysis (LIA and ACB, $n = 94$) did not reveal significant differences in VAS pain before discharge (LIA 2.4 ± 1.4 vs. ACB: 2.7 ± 1.5 , $p = 0.122$) or total MMEs (LIA 18.6 ± 6.7 vs. ACB 17.9 ± 7.1 , $p = 0.532$).

CONCLUSION: The use of ACB or LIA resulted in similar pain levels and opioid consumption during early recovery after ACLR surgery.

LEVEL OF EVIDENCE: III, Retrospective Comparison Study

Paper 219

Failure Risk of BTB Autograft Vs. Quadrupled Semitendinosus Autograft in a Teenage Population Undergoing ACL Reconstruction

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INTRODUCTION: ACL reconstruction is among the most performed orthopedic procedures; however, reconstruction failure remains a problem. Debate continues over the best graft choice for ACL reconstruction, particularly in the high-risk teenage population. Direct comparisons of failure risk between large hamstring autografts and patellar tendon autografts in the teenage population are limited. The purpose of this study is to compare outcomes following ACL reconstruction with patellar tendon autograft (BTB) vs. quadrupled semitendinosus autograft (ST) in the teenage population. We hypothesize there are no differences in ACL graft failure risk between teenagers reconstructed with patellar tendon autografts and quadrupled semitendinosus autografts.

METHODS: Retrospective chart review identified 276 consecutive teenage patients undergoing ACL reconstruction with quadrupled semitendinosus autograft or patellar tendon autograft at an academic medical center between 2013 and 2020. Patient age, sex, and body mass index at the time of ACL reconstruction were recorded, as well as whether subsequent ACL revision was performed.

RESULTS: Mean follow-up was one year. Revision ACL reconstruction was performed in 5 of 66 patients in the BTB group (7.6%) and 17 of 210 patients in the quadrupled semitendinosus group (8.1%) ($p = 1.00$). No significant differences in patient's age (BTB: 16.9 years, ST: 16.6 years), sex (BTB: 50% females, ST: 49% female), or BMI (BTB: 25.1 kg/m², ST: 24.6 kg/m²).

CONCLUSION: There is no difference in the early failure risk of BTB autograft and quadrupled semitendinosus autograft in a teenage population undergoing primary ACL reconstruction.

Paper 220

Compartmental Static Anterior Tibial Translation After ACL Reconstruction: A Quantitative MRI Study

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INTRODUCTION: The mechanisms responsible for accelerated cartilage deterioration in anterior cruciate ligament (ACL) injured knees are not well established. Abnormal tibiofemoral spatial relationship, resulting from ACL deficiency, has been purported as a potential contributor to altered cartilage loading and, consequently, accelerated PTOA. On magnetic resonance imaging (MRI), ACL-injured knees have been found to exhibit excess static anterior tibial translation (ATT) relative to control knees of separate, uninjured patients. However, the quantitative extent of ATT restoration following ACL reconstruction (ACLR) is largely unknown. We aimed to determine if ACLR restores static ATT of the lateral and medial compartments in comparison to the contralateral knee. We hypothesized ACLR would not restore static ATT of the lateral and medial compartments back to the normal position.

METHODS: A prospective cohort study consisting of 25 patients with an acute ACL injury was designed. MRI scans of both the injured and uninjured knees were performed preoperatively within 1 month of ACL injury and 6 months after ACLR. ATT of the lateral tibial plateau (LTP) and medial tibial plateau (MTP) was measured using a previously validated measurement method. ATT was defined as the anterior-to-posterior distance between the posterior aspect of the femoral condyle and tibial plateau on the mid-sagittal T1 MRI slice from the MTP and LTP. Two-way analysis of variance (ANOVA) testing was performed to compare ATT between knees before and 6 months after ACLR (limb x time).

RESULTS: ACL-injured knees exhibited higher LTP ATT than uninjured control knees, regardless of timepoint (Preop: Injured = 5.61 ± 2.53 mm; Uninjured = 3.09 ± 2.04 mm; 6 months postop: Injured = 4.90 ± 2.43 mm; Uninjured = 3.18 ± 1.86 mm, $p = 0.0002$). LTP ATT trended towards decreasing in the injured limb after ACLR but the difference did not reach statistical significance ($p = 0.15$). ACL-injured knees also exhibited higher MTP ATT than uninjured control knees (Preop: Injured = 1.71 ± 2.68 mm; Uninjured = 0.15 ± 2.56 mm; 6 months postop: Injured = 1.79 ± 2.53 mm; Uninjured = 0.31 ± 2.62 mm, $p = 0.003$). There was no significant interaction of limb and time in the MTP ($p = 0.82$).

CONCLUSION: ACLR did not restore pathologic LTP and MTP ATT back to levels present in uninjured knees. Persistent pathologic tibiofemoral relationships may contribute to abnormal cartilage loading and possible accelerated PTOA. Further study of early chondral changes after ACLR as a function of ATT are necessary.

Paper 221

Utilization of Synthetic Bone Graft Substitute for Bony Defect in Two-Stage Revision ACL Reconstruction

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INTRODUCTION: Despite recent improved ACL reconstruction techniques, tunnel widening associated with earlier techniques provides orthopedic surgeons with intraoperative challenges in revision cases. Mechanical and biomechanical factors are potential contributors to widening and ACL insufficiency. The purpose of this study was to assess calcium sulfate bone graft substitute in revision ACL reconstruction patients to evaluate radiographic outcomes, recovery, and complications. Although benefits of bone graft substitutes including decreased morbidity, availability, and sterility have been reported, substitutes have not been evaluated in revision ACL surgery.

METHODS: Subjects were identified retrospectively from a surgical database and cross-referenced with billing data identifying patients with CPT code 20680 between 2012-2017. Subjects who underwent two-stage revision ACL reconstruction with calcium sulfate bone graft were included in the series. Investigators reviewed operative records to determine duration between procedures, return to activity, and complications. Preoperative and postoperative radiographic imaging was reviewed by the primary investigator to evaluate dimensions of void and status of bone graft substitute at interval and latest possible post-surgical.

RESULTS: Eight subjects met inclusion criteria. Mean age at time of revision procedure was 34.3 years. Mean time between index procedure and revision was 7.0 years. Mean maximum preoperative tibial tunnel width was 14.34 mm (range 8.5-25 mm), while femoral tunnel width was 13.12 mm (range 10-16.4 mm). First stage of procedure included mean 10.8 mL (40% hydroxyapatite, 60% calcium sulfate in 5 cases, 75% calcium sulfate, 25% calcium phosphate in 3 cases) of bone graft. No serous drainage was identified in postoperative bone graft implantation. Interval imaging at mean 4.25 months demonstrated incorporation of the bone graft material with native tunnel margins in all 8 subjects. The time between bone graft implantation and revision ACL reconstruction was 6.3 months (range 3-13 months). Return to activity following ACL reconstruction was mean 8.0 months (range 5-15 months). Postoperative radiographic analysis performed at mean 18.4 months (range 4-54 months) demonstrated no evidence of bone graft substitute peripheral radiolucency and no evidence of tunnel widening.

CONCLUSION: Utilization of calcium sulfate bone graft substitute in a 2-stage revision ACL procedure demonstrates successful bone void integration with no evidence of associated serous drainage in this series of subjects. Calcium sulfate bone graft substitutes appear to be an effective alternative to dowels and other materials in irregular defects in ACL revision cases. Further study of this technique is warranted.

Paper 222

Incidence, Common Pathogens, and Risk Factors for Infection after Anterior Cruciate Ligament Reconstruction: A Systematic Review

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OBJECTIVE: Infection after anterior cruciate ligament (ACL) reconstruction is a relatively rare complication, but may increase the risk of poor functional outcomes. The purpose of this systematic review is to systematically assess the current literature to present a comprehensive summary of the incidence, common pathogens, and risk factors for infection after ACL reconstruction.

METHODS: PubMed, CINAHL, EMBASE, and Scopus databases were searched for relevant studies reporting on infection after ACL reconstruction (keywords – infection and anterior cruciate ligament reconstruction). Two reviewers independently screened the extracted studies for adherence to the following inclusion and exclusion criteria. Studies were selected if they reported on the incidence of infection, pathogens cultured from infected knees, or risk factors for infection after primary ACL reconstruction. All dates were included. Exclusion criteria included studies with less than 100 patients or studies that included revision ACL reconstruction.

RESULTS: Forty-eight studies met the inclusion and exclusion criteria, reporting on a total of 366,687 ACL reconstructions. The overall incidence of infection was 0.596% (0.147% - 2.44%). Included studies evaluated between 123-104,255 patients. The most common pathogens were *Staphylococcus aureus*, *Staphylococcus epidermidis*, and coagulase-negative *Staphylococci* (CNS). Five studies reported that the use of hamstring autograft was a statistically significant risk factor for infection after ACL reconstruction, thus, making hamstring autograft the most commonly reported risk factor. Other common risk factors included male sex, use of immuno-suppressive medications or use of intraarticular steroid injections, prior knee surgery, and diabetes.

CONCLUSION: Systematic review of the literature revealed that infection after ACL reconstruction remains an infrequent event with an incidence of 0.60% (0.15%-2.44%). Furthermore, the most common pathogens are from the *Staphylococcus* genus of bacteria. Hamstring tendon autograft use was identified as the most common risk factor for infection. Together, this information may help guide physicians in the prevention and treatment of infection after ACL reconstruction.

Paper 223

Effect of Graft Choice on Skeletal Muscle Atrophy and Knee Joint Swelling Following Anterior Cruciate Ligament Reconstruction

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Involved limb (IL) skeletal muscle atrophy and knee joint swelling compared to the uninvolved limb (UL) is common following anterior cruciate ligament reconstruction (ACLR), but the effect of autograft source on atrophy and swelling is poorly understood. The purpose of this study is to analyze the effect of graft source on circumferential measurements of the thigh, calf, and knee post-ACLR.

An honest broker provided anonymous data from our institution's ACLR return-to-play (RTP) repository, which contains patient measures from RTP assessments conducted as part of standard patient-care protocols at multiple time points post-ACLR. Patients were included in the analysis if they had one or more circumferential measurements, which included knee joint line (KNEE), mid-calf (CALF), and thigh 6in (THIGH6), 10cm (THIGH10), and 20cm (THIGH20) proximal to the patella. 771 observations of 503 patients (20.5 ± 7.2 y at ACLR, range: 11-56y, 269 male and 234 female) were included. The dependent variables were the side-to-side difference between circumferences (IL-UL). The categorical independent variable was graft choice including patella (BTB) and hamstring tendon (HT) autografts. Time post-ACLR was a continuous independent variable. The data was analyzed using linear mixed-effects models with the fixed and random effect of time post-ACLR and the fixed effect of graft choice. Each patient was assigned a random intercept and slope. Significance was set to $p < 0.05$.

Soon after ACLR, IL CALF and THIGH demonstrate skeletal muscle atrophy relative to UL and the IL KNEE demonstrated continued swelling relative to UL; however, there is no evidence that the degree of atrophy and swelling differs between BTB and HT. One notable finding is that THIGH IL shows a large degree of atrophy, likely related to quadriceps weakness commonly seen post-ACLR. As time progresses post-ACLR, IL CALF and THIGH become more similar to UL, but there is no evidence that KNEE changes over time. Further, there is no evidence that time post-ACLR affects BTB and HT differently. Overall, results indicate that BTB and HT demonstrate similar degrees of skeletal muscle atrophy and knee joint swelling soon after ACLR and similar rates of atrophy resolve with time.

Paper 224

How Safe is Platelet-Rich Plasma in Orthopaedics? A Systematic Review

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INTRODUCTION: Platelet-rich plasma (PRP) injections have been gaining popularity to treat a wide variety of Orthopedic conditions. As the evidence grows supporting PRP's efficacy, it is essential to understand the risks of this intervention. The aim of the current systematic review is to describe and quantify both major and minor complications associated with PRP injections.

METHODS: A search of the literature was performed in June 2011 using the search terms "(platelet rich plasma OR PRP) AND (orthopedic or knee or shoulder or hamstring or osteoarthritis or tendinopathy or epicondylitis or plantar fasciitis or rotator cuff or ankle or hip) NOT review". A total of 1,336 studies were screened to determine eligibility which lead to a total of 189 potential manuscripts for inclusion. These manuscripts were then searched for inclusion of complications or adverse events associated with PRP injections. Only level 1 or 2 evidence was included for review.

RESULTS: A total of 64 manuscripts were included for final review. There was a total of 2,142 PRP injections given, with a median 26.5 injections per study. Forty-seven studies had 40 PRP injections or fewer and 4 of the studies included more than 100 PRP injections given. There was a total of 226 (10.5%) complications described in the included studies. Of these, there were 54 (2.5%) major and 136 (6.3%) minor complications. Forty-five of the included studies reported no complications. Major complications were found in only six studies: four were extraarticular PRP usage in tendinopathies or epicondylitis, and two were intraarticular injections for knee osteoarthritis and sacroiliac joint pain. Major complications included 13 frozen shoulders, 10 severe pain, 6 DVTs, and 6 Achilles re-ruptures. The incidence of frozen shoulder was the only complication found to be significantly higher in the PRP group than comparisons. Mild, transitory pain and swelling was commonly reported but not quantified. Of the 136 minor complications, 115 were related to pain. Other minor complications included 1 sciatic nerve irritation, 1 local dermal hyperesthesia, 1 chemical bursitis, 17 nausea and dizziness, and 1 contralateral knee pain.

CONCLUSION: PRP injection is a safe intervention, with a low risk of complications overall, and a very low risk of major complications. Major complications are uncommon, and very uncommon in the management of osteoarthritis. Minor pain and swelling were the most common minor complications following PRP injection.

Paper 225

Association Between Self Perceived Psychological Readiness and Function at Time of Return to Sport in Anterior Cruciate Ligament Reconstruction Patients

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Anterior cruciate ligament (ACL) injuries frequently affect active young adults. While mechanical stability of the knee is often restored, studies have shown that less than half of patients return to a competitive sport. Survey tools are often used to glean information about patients' functional and psychological states to inform clinical decisions and return to sport (RTS) timing. The ACL Return to Sport after injury scale (ACL-RSI) quantifies emotions, risk appraisal, and confidence. The international Knee documentation Committee subjective knee form (IKDC) quantifies patient-reported functional outcomes after knee surgery. Sadeqi et al. (2018) demonstrated a strong correlation between ACL-RSI and IKDC at two years post-ACL reconstruction (ACLR); however, there is a lack of data on the relationship between IKDC and ACL-RSI in the first year post-ACLR. This study aims to explore the relation between IKDC and ACL-RSI in ACLR patients at the time of RTS testing, approximately six to nine months post-ACLR.

An honest broker provided anonymous data from our institution's clinical ACLR RTS repository, which contains patients measures from RTS tests conducted as part of standard patient care. Fifty-six ACLR patients (20.1 ± 7.9 y at ACLR, $1.73 \pm .11$ m, 76.7 ± 16.5 kg, 29 male and 27 female) were included in this study. Patients completed the ACL-RSI and IKDC at RTS testing ($.66 \pm .16$ y post-ACLR) before resuming full, unrestricted sports participation. A linear mixed-effects model was used to evaluate the relationship between the continuous dependent variable of IKDC and the fixed continuous independent variable of ACL-RSI. Time post-ACLR was entered as a random effect to account for patients doing RTS testing at different time points post-ACLR. Significance was set to $p < .05$.

Mean IKDC and ACL-RSI were 90.5 ± 7.5 and 80.6 ± 17.2 , respectively. The model indicated that IKDC and ACL-RSI were positively associated ($F = 5.54$, $p = .022$). For each 1 unit increase in ACL-RSI, IKDC increased 0.13 [.02, .25] points suggesting that as self-perceived function improves post-ACLR, psychological readiness factors including emotion, risk appraisal, and confidence improve as well. These results align with the findings of Sadeqi et al. at two years post-ACLR and demonstrate that physiological and functional improvements are also positively associated approximately eight months post-ACLR. If patients are not demonstrating adequate ACL-RSI and IKDC scores, further assessment may be warranted before athletes are permitted to return to full, unrestricted athletic participation.

Paper 226

An Activity Scale for All Youth Athletes? An Analysis of the HSS Pedi-FABS in 2274 Pediatric Sports Medicine Patients

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BACKGROUND: The HSS Pedi-FABS activity scale has become increasingly used in children ages 10-18 since its development in 2013. Research reports on the measure in general youth athletes with knee injuries, however, limited information is available regarding use in evaluating a variety of injuries, a varying sports, or specialized athletes. The purpose of this study assessed the sensitivity and distribution of Pedi-FABS in an athletic youth population. Secondly, this study evaluated Pedi-FABS association with PROMIS® Pediatric Global Health 7(PGH7) with Pain interference(PGHPI) and Fatigue(PGHF) components.

METHODS: A retrospective review of athletes ages 10-18 presenting at a single pediatric sports medicine practice between 4/2016-7/2020 was performed. Participants were included if they completed a pre-visit intake questionnaire and Pedi-FABS. Descriptive statistics were used to analyze Pedi-FABS distribution and the presence of a ceiling effect in demographic, injury characteristic, and sports participation subgroups. A ceiling effect was determined to be present if more than 15% of respondents scored the highest possible score. A Kruskal-Wallis test used to compare average scores in each subgroup. Spearman's Correlations were calculated to assess the association of PGH with Pedi-FABS.

RESULTS: 2,274 patients(14.6 ± 2.1 years; 53.0% females) were included. Of these, 2,010 youth athletes reported participating in sports for 9.6 ± 7.9 hours per week during 32.3 ± 15.7 weeks per year with 6.2 ± 3.4 years of participation in 21 distinct primary sports. 80.3% of patients reported participation in only one sport. Pedi-FABS score differences were found across demographic and sport participation subgroups. No ceiling effects were noted in any subgroups.

Pedi-FABS correlated with hours/week($r = 0.20$), days/week($r = 0.28$), weeks/year($r = 0.12$), and years of participation($r = 0.16/p < 0.01$). An inverse correlation was observed between Pedi-FABS and Days from injury to Presentation($r = -0.21/p < 0.01$). An association between general health and activity level was noted as all three PGH components correlated with Pedi-FABS(PGH7: $r = 0.28$ /PGHF: $r = -0.16$ /PGHPI: $r = -0.12$, $p < 0.01$).

CONCLUSION: Correlations with self-reported activity without ceiling effects demonstrates the validity and sensitivity of Pedi-FABS for use in athletes with different primary sports and injury types. Additionally, differences between demographic and sport participation subgroups, as well as associations with days to presentation and a commonly used patient reported outcome measure, may demonstrate the utility of Pedi-FABS for sports medicine clinicians.

Paper 227

RTP, Game Utilization, and Performance in MLB Pitchers and Positional Players After Arthroscopic Shoulder Labral Repair

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PURPOSE: Investigate the impact of arthroscopic shoulder labral repair on return to play (RTP), career longevity, workload, and performance of Major League Baseball (MLB) athletes.

METHODS: A retrospective review of MLB players after arthroscopic shoulder labral repair from 2004-2018 was performed. A 2:1 control group matched by demographic information was used. Demographics, workload, and performance metrics were collected. Statistical analysis examined workload/performance at one and three-years after injury compared to one-year before. Workload/performance percentage relative to baseline was also compared.

RESULTS: 26/39 (66%) pitchers and 18/25 (72%) positional players RTP and were matched with 54 and 34 controls, respectively. Following surgery, players experienced shorter careers (2.3 ± 2.6 vs. 5.8 ± 2.8 , $p < 0.001$, pitchers), (2.9 ± 2.5 vs. 5.3 ± 2.3 , $p = 0.002$, positional players). One-year post-index, pitchers experienced reductions in games played (GP) (22.0 ± 21.3 vs. 32.1 ± 21.0 , $p = 0.002$), started (15.0 ± 14.1 vs. 6.1 ± 6.5 , $p = 0.0038$), and innings (109.5 ± 73.2 vs. 44.7 ± 29.3 , $p = 0.0004$), and increased walks/hits-per-inning-pitched (1.3 ± 0.2 vs. 1.5 ± 0.3 , $p = 0.0035$). One-year post-index, positional players demonstrated reductions in GP (98.0 ± 50.7 vs. 75.7 ± 47.1 , $p = 0.0399$), innings (778.9 ± 431.6 vs. 528.6 ± 429.9 , $p = 0.0263$), on-base-percentage (0.3 ± 0.1 vs. 0.3 ± 0.1 , $p = 0.0116$), and on-base-plus-slugging-percentage (0.7 ± 0.2 vs. 0.6 ± 0.2 , $p = 0.0281$). Compared to controls, pitchers had decreased GP (50 ± 40 vs. 150 ± 180 , $p < 0.001$) and innings (40 ± 30 vs. 150 ± 190 , $p < 0.001$), and increased walks/hits-per-inning-pitched (120 ± 20 vs. 100 ± 20 , $p = 0.027$) one-year post-index. Positional players had decreased on-base-percentage (80 ± 30 vs. 110 ± 40 , $p = 0.017$) and on-base-plus-slugging-percentage (80 ± 30 vs. 100 ± 20 , $p = 0.019$) one-year post-index and decreased on-base-percentage three-years post-index (90 ± 20 vs. 100 ± 20 , $p = 0.017$).

CONCLUSIONS: Following RTP after arthroscopic shoulder labral repair, MLB players had reduced career longevity and workload/performance one-year post-index.

STUDY DESIGN: Level III: Retrospective Case-Control Study

Paper 228

The Association Between The Chase Utley Rule and Collision-Related Injuries in Major League Baseball

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BACKGROUND: During an average professional baseball season, over 300 injuries are attributed to slides. While slide-related injuries among offensive players were investigated in a previous study, injuries to defensive players that may occur as the result of a slide are less well-defined. Major League Baseball (MLB) adopted a Rule 6.01(j) in 2016 to reduce the number of collisions during slides. It remains unknown if this rule change was associated with improved player safety.

METHODS: Using data from the comprehensive MLB Health and Injury Tracking System (HITS), we quantified the number of collision-related injuries for defensive (i.e. fielding) players in the infield in Major and Minor League Baseball from the 2010-2019 seasons. We compared the median number of collision-related injuries for defensive players in the infield prior to (2010-2015) and in the seasons following (2016-2019) the implementation of Rule 6.01(j). Three additional analyses were performed to support or contradict a conclusion that any observed reduction in injuries at the start of the 2016 season were likely due to the change to Rule 6.01(j).

RESULTS: The median number of collision-related injuries for defensive players at second base in the pre-rule change seasons (the 2010 through 2015 seasons) was 58.5. In the seasons following the rule change (the 2016 through 2019 seasons), the median number of collision-related injuries for defensive players at second base decreased to 37.5 injuries per season, a 36% decrease ($p = 0.019$, difference in location 19.5, 95% confidence interval (CI) 5.0-31.0).

in contrast, the median number of collision-related injuries at first base decreased by only 14.1%, from 49.5 pre-rule change to 42.5 post-rule change ($p = 0.16$, difference in location -8.0, 95% CI -4.0 – 18.0), and the median number of collision-related injuries per season at third base was unchanged at 15 per season.

CONCLUSION: This rule change was associated with a decrease in the number of collision-related injuries, with the largest effect observed as expected at second base. It is critical for surgeons and league officials across youth and professional sports to understand the impact of different player safety rules. Although it is often difficult to implement rule changes in professional and youth sports, the results of this study are a cause for optimism that MLB and the Major League Baseball Players Association can continue to work together in the pursuit of improved player safety.

Paper 229

Despite Understanding of Injury Risk, There is Widespread Use of Weighted Baseballs Among Elite Athletes: A Multi-Center Survey Study

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PURPOSE: Weighted baseball use during throwing programs is widespread; however, their use remains controversial. Prior research has shown weighted baseball programs can help increase ball velocity in some athletes, but it has also shown potential increased risk for throwing arm injury. The purpose of this study was to ascertain perceptions weighted baseball use amongst elite baseball players.

METHODS: An online survey was created with questions targeting common practices, throwing regimens, risk factors for injury, and usage history of weighted baseball programs in baseball players. The questions were modeled to ascertain the perceptions of elite baseball players in order to gain a better understanding of their experience with weighted baseballs. Descriptive statistical analysis was performed.

RESULTS: A total of 376 baseball players with mean age of 20 ± 2 years completed the survey and 64% (239/376) were pitchers. Among all participants, 71% (267/376) reported using a weighted baseball training program at some point in their career. Of those, 75% (199/267) believed their weighted baseball program helped make them a better player. Overall, 73% (275/377) of players believed a weighted baseball training program is a risk for injury, while 17% (46/267) of players who used a weighted baseball program attributed an injury to their use of weighted baseballs. Overall, participants reported a mean $72\% \pm 30\%$ likelihood of future weighted baseball use.

CONCLUSION: In this survey study of elite adult baseball players, a majority of participants reported prior use of weighted baseball training programs along with a corresponding improvement in pitching performance. This is despite an acknowledgement of the inherent increased injury risk associated with their use. Nearly 20% of players attributed pain or injury to use of weighted baseballs. Moreover, a majority of players surveyed intend to continue using weighted baseballs in the future due to the perceived performance benefit.

Paper 230

Retired NFL Players Face Increased Risk of Osteoarthritis and Joint Replacement

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BACKGROUND: The dangers that active NFL players face are well described and document multisystem afflictions and injury prevalence. However, the literature discussing the long-term effects of playing professional football is still in its infancy. The purpose of this study was to summarize the current literature on the long-term musculoskeletal issues in the retired NFL player population.

METHODS: PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were followed. The inclusion criteria were: (1) study population consisted of retired players of the National Football League and (2) study focused on injuries or lasting morbidities of the musculoskeletal system. Data on total knee arthroplasty (TKA) and total hip arthroplasty (THA) were extracted for meta-analysis, and Chi-Squared tests were run to compare retired NFL and general populations.

RESULTS: Nine studies were included, with a total of 16,593 retired NFL players. Six of the nine studies had an evidence level of III, and three of the nine studies had an evidence level of IV. The average age of the retired players was 54.6 years old. The prevalence ratio of overall arthritis in retired players vs. (age matched) U.S. males was 2.2 (95% CI: 2.1-2.3). Prevalence ratios for ankle osteoarthritis were shown correlate positively with the number of foot and ankle injuries (1-2 injuries, PR = 1.16, 95% CI: 1.02-1.32; ≥ 6 injuries, PR = 1.34, 95% CI: 1.12-1.59). This theme was also present when examining other lower extremity injuries. Differences ($p < 0.001$) were obtained for age matched groupings of retired NFL players and the general population when comparing the prevalence of TKA and THA, with the retired NFL population having a higher rate of arthroplasty. Players that reported having 1 previous knee injury had a prevalence ratio for TKA of 1.78 (95% CI: 1.14-2.77), while players that reported a history of ≥ 3 knee injuries reported a prevalence ratio for TKA of 3.44 (95% CI: 2.33-5.09). This trend was also present when examining the prevalence of THA ($p < 0.05$).

CONCLUSION: This review demonstrates the effects of NFL related lower extremity injuries extend beyond the players' careers and presents as a higher risk for osteoarthritis and total hip and knee replacement.

Paper 231

Patient's Perceptions of Regenerative Medicine: What Can It Do For You?

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INTRODUCTION: Patients now have longer life expectancies and more active lifestyles which is driving the growth and use of regenerative medicine. Definitions of regenerative medicine (RM) vary, with much of the public having an incomplete understanding of what regenerative medicine means or the science behind these therapies. The purpose of this study was to assess public perceptions, knowledge, and attitudes toward regenerative medicine and its application in shoulder and sports medicine.

METHODS: This anonymous self-administered survey was designed to assess patient perceptions, knowledge, and attitudes toward regenerative medicine and its application in shoulder and sports medicine. The survey was distributed to 150 participants with shoulder problems who visited the department of orthopedic surgery at a single institution. The survey was divided into two sections: Part 1, patient demographics and Part 2, participant's knowledge and conceptions of regenerative medicine. Descriptive statistics and analyses were performed based on demographic variables using independent t-test and an analysis of variance (ANOVA).

RESULTS: Of the participants, 51.3% were male and 68% was over the age of 55. The majority (76%) of the participants were Caucasian with college degree or higher (80.1%) and an income of over \$90,000 (62.1%). Overall, participants agreed they had some understanding of regenerative medicine 3.49 (SD+/-1.024), agreed on the effectiveness of RM as a therapy (3.55 (SD+/-1.03)) and agreed on likelihood to consider RM therapies (3.85 (SD+/-0.92)). RM therapies were seen in a positive view by 70% of survey participants. Participants with a positive view scored significantly higher in all aspects of the survey including effectiveness of RM ($p = 0.04$) and the likelihood to use or recommend RM therapies ($p < 0.001$). Education status did not demonstrate a significant difference in responses ($p = 0.40$). Older participants (over 54 years) scored higher for reported basic knowledge on RM (3.63; $p = 0.02$) and participants with personal experience with RM had a more positive response toward attitudes to RM (3.87 vs. 3.38; $p = 0.01$) and were more comfortable recommending it to others (3.83 vs. 3.41; $p = 0.04$).

CONCLUSION: Overall patients had a moderate level of understanding and positive perception of effectiveness of regenerative medicine therapies. Our results demonstrated 70% of participants had a positive view of these treatment modalities despite the fact that the literature does not support efficacy. More research clearly needs to be dedicated to this area of medicine given the public interest and desire for these RM treatments to treat orthopedic problems.

SUMMARY: Survey participants reported a moderate level of understanding and strong positive perception of effectiveness of regenerative medicine therapies, more research needs to be focused in RM therapies given the public interest.

Paper 232

Lower Extremity Injury Following Return to Sport from Concussion: A Systematic Review

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PURPOSE: To examine the current body of research and determine whether there is an increased risk for LE musculoskeletal injury following a concussion and identify populations at an increased risk.

METHODS: A systematic review of the literature from January 1, 2000, to September 30, 2020, was performed using MEDLINE and PubMed databases. Key words included concussion, athlete, lower extremity injury, and return to sport. Inclusion criteria required original research articles written in English language examining the rate of LE injuries following a diagnosed concussion. Data extracted from each study included number of subjects, age, sex, sport played, level of play, odds ratio (OR) of injury, and number of concussions per athlete.

RESULTS: A total of 13 studies involving 4,349 athletes (88.1% male; mean age 19.8 years) met inclusion criteria. Athletes were classified as either high school (46.1%), collegiate (17.0%), or professional (36.9%). Four studies demonstrated an increased risk of LE injury within 90 days of a diagnosed concussion (OR 3.44, 95% CI 2.99-4.42) and 7 studies revealed an elevated risk of injury within one year of concussion (OR 1.85, 95% CI 1.73-2.84). Professional and college athletes demonstrated an increased risk (OR 2.49, 95% CI 2.40-2.72; OR 2.00, 95% CI 1.96-2.16, respectively) compared to high school athletes (OR 0.97, 95% CI 0.89-1.05). A stepwise increase in risk of sustaining a LE injury was observed with multiple concussions, with increasing risk observed from 2+ (OR 2.29, 95% CI 1.85-2.83) to 3+ career concussions (OR 2.86, 95% CI 2.36-3.48).

CONCLUSION: An increased incidence of LE injuries was observed at 90-days and one year following the diagnosis of a concussion. Higher levels of competition, such as at the collegiate and professional level, resulted in an increased risk of sustaining a subsequent LE injury following a diagnosed concussion. These results suggest an at-risk population which may benefit from injury prevention methods following a concussion.

Paper 233

Hamstring Strength Variation Among Football and Soccer Athletes

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BACKGROUND: Eccentric strength imbalance is considered a contributing factor in hamstring injuries. Various factors promote hamstring asymmetry, including body mass and positional differences; however, no literature has investigated this divergence in athletes across various age, sex, skill level, and sports. Our study aims to identify factors that may impact hamstring strength variability in soccer and American football athletes.

METHODS: Male (M) and female (F) High School (HS) and collegiate Soccer players, as well as male HS and Collegiate American Football and Professional Soccer athletes were consented and enrolled into the study. Athlete age, weight, sport, skill level, and Hamstring force measures (using the NordBord Hamstring Testing System) were obtained. Forces were normalized to body weight (kg). Independent T-tests were used to compare mean force values between athlete groups and bivariate correlation was used to find associations between age and weight with force measures within each cohort.

RESULTS: 537 athletes completed force measurements, with 71M and 10F HS soccer, 287M HS football, 19M and 16F college soccer, 93M college football, and 41M professional soccer players. Force discrepancies were observed with male soccer players across age, skill level, and sport. Maximum, average, and impulse imbalance percentages were negatively correlated with age in this cohort ($p < 0.05$). Additionally, the same imbalance measures were significantly different between HS male soccer players and professional soccer, HS football, and college football athletes ($p < 0.05$). Sex-based differences were noted with maximum, average, and impulse imbalance percentages between female HS soccer players and HS and collegiate football and professional soccer players ($p < 0.05$).

CONCLUSION: Hamstring imbalances were seen primarily in soccer athletes, with notable left leg strength predominance. No imbalance differences were revealed between skill levels of American football or female soccer players. Future work should investigate correlation between force imbalances and position, as well as risk for hamstring injury.

Paper 234

Early light-duty after shoulder arthroscopy is associated with an earlier return to full-duty in Workers' Compensation Patients

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BACKGROUND: Patients receiving workers' compensation (WC) have often been associated with poorer outcomes compared to non-workers' compensation (NWC) patients. Several studies reveal that WC patients take a longer time to return to work (RTW) than patients not receiving WC.

HYPOTHESIS/PURPOSE: The purpose of this study is to investigate the impact of earlier return to light duty as related to its effect on return to full duty in WC patients that underwent shoulder arthroscopy.

METHODS: Chart review was performed on all WC patients treated by two senior authors between the years 2011 and 2018. All patients that underwent shoulder arthroscopy were initially included in the study. Exclusion criteria included patients with a fracture or having undergone arthroplasty. Two groups were established. Group 1 went back to light duty work within the first 100 days after surgery. Group 2 consisted of patients who did not go back to light duty work within 100 days after surgery, including those who did not RTW. Preoperative demographic information, as well as specific procedures performed during the shoulder arthroscopy were considered. The primary outcomes included: length of time from surgery to light duty and length of time from surgery to return of full-duty work level.

RESULTS: There was a strong correlation between the number of days the patients were released to light duty and the number of days they were released to full duty ($r^2 = 0.52$). Twenty of the 25 patients (80%) in group 1 (light duty \leq 100 days) went back to full duty, whereas only 9 of the 35 (26%) in group 2 returned to full-duty work. The rate of return to full duty was significantly higher in patients that returned to light duty within 100 days.

DISCUSSION: This study identified a strong correlation between earlier return to light-duty work and an earlier return to full duty in WC patients that underwent shoulder arthroscopy. The secondary objective revealed that patients returning to light duty in the first 100 days had a higher rate of return to full duty. This evidence suggests that in order for patients to return to full duty more expediently, employers and physicians should collaborate to find a safe position in the workplace for patients as they continue to heal before reassignment back to full duty of work.

Paper 235

The More the Merrier? Meniscus Implants - An Analysis of All-Inside Repair Failure

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BACKGROUND: All-inside meniscal repair implants were developed to decrease surgical time and complications relative to inside-out meniscal repair. Large or complex meniscal tears may require a high number of implants for adequate repair. The purpose of this study is to evaluate the relationship between the number of all-inside meniscal repair implants placed and the risk of repair failure. We hypothesized that the use of higher numbers of all-inside meniscus repair implants would be associated with increased failure risk.

METHODS: A retrospective chart review identified 523 meniscus repairs performed in 473 patients between 2006 and 2013 by a sports medicine fellowship-trained orthopedic surgeon at a single institution. Patient demographics (age, BMI, sex) and surgical data (medial or lateral meniscus, number of implants used, and concomitant ACL reconstruction) were recorded. Repairs in both menisci, inside-out and outside-in repairs, and patients who received an unspecified number of implants were excluded. Repair failure was identified through chart review or patient interviews defined as a repeat surgery on the index knee such as partial meniscectomy, TKA, meniscus transplant, or repeat repair. Logistic regression modeling was utilized to evaluate the relationship between the number of implants used and repair failure.

RESULTS: 293 patients who underwent all-inside meniscus repair were included with a mean follow-up of 3.93 years following surgery. Repair failure was noted in 24.4% of medial and 19.7% of lateral meniscus repairs. No significant increase in failure was observed with increasing number of all-inside medial (OR 1.10, 95% CI 0.81-1.49, $p = 0.542$) or lateral (OR 0.80, 95% CI 0.45-1.41, $p = 0.430$) implants after controlling for patient age, BMI, and concomitant ACLR.

CONCLUSION: A higher number of all-inside implants does not significantly increase odds of meniscus repair failure. This may influence surgical decision making when considering the use of additional implants to achieve a stable meniscus tear repair.

Paper 236

Prospective Consecutive Clinical Outcomes Following Transtibial Root Repair for Posterior Meniscal Root Tears: A Multi-Center Study

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BACKGROUND: Prospective evaluation of clinical outcomes following posterior meniscal root repair utilizing a transtibial pullout technique is limited, and factors that may contribute to outcomes are unclear.

HYPOTHESIS/PURPOSE: We hypothesized an overall significant improvement in outcomes after root repair and differences in clinical outcomes correlated with age, BMI, sex, and meniscal extrusion.

STUDY DESIGN: Prospective cohort study; Level of evidence, 3.

METHODS: Consecutive patients undergoing transtibial medial or lateral meniscus root repair were prospectively enrolled at two orthopedic centers between March 2017 and January 2019. Pre- and postoperative MRIs were obtained to assess for meniscus healing, quantification of extrusion, articular cartilage grade, and subchondral bone changes. Patient-reported outcomes including International Knee Documentation Committee (IKDC) scores, Tegner Activity Scale, and Visual Analog Scale (VAS) for pain were collected preoperatively and two-years postoperatively. Patients were then subdivided by clinical and demographic characteristics to determine factors associated with clinical outcomes.

RESULTS: 45 patients (29F:16M) with an average age of 42.3 (SD 12.9) and BMI of 31.6 who underwent 47 meniscal root repairs (29 medial, 16 lateral, 2 had both) were prospectively enrolled in the study. IKDC (41.1 vs. 78.4, $p < .001$), Tegner (3 vs. 4, $p < .001$), and VAS (2.8 vs. 0.9, $p < .001$) significantly improved at two-year follow-up. BMI, preoperative malalignment, cartilage status, and progressive meniscus extrusion ($\Delta = 0.7$ mm) did not have a negative impact on patient-reported outcomes (IKDC and Tegner) at two-years postoperatively. Age ≥ 50 years and extrusion pre- and postoperatively were associated with decreased patient activity level (Tegner). Progressive meniscus extrusion was associated with a decreased overall improvement in activity level (Δ Tegner).

CONCLUSION: Transtibial root repair for medial and lateral posterior meniscus root tears demonstrated significantly improved clinical outcomes at two-years postoperatively. Increased age, increased BMI, cartilage status, and meniscal extrusion did not have a negative impact on short-term functional outcomes (IKDC), but age ≥ 50 years and extrusion negatively influenced patient activity level (Tegner).

Paper 237

Clinical Outcomes of Fixation of Radial Meniscus Tears

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INTRODUCTION: Radial meniscus tears are challenging knee injuries due to loss of hoop stresses and involvement of the relatively avascular zones of the meniscus which can render the meniscus incompetent. The previous surgical method of repair was meniscectomy; however, modern techniques favor the preservation of the native meniscus to improve the outcome of the patient and prevent long-term damage. Several biomechanical studies have been published regarding repair methods for radial meniscus tears. To improve patient outcomes, the reinforced suture bar (Rebar) repair technique was studied which demonstrated lower rates of suture cutout and higher load to failure in cadaveric studies. The purpose of the study was to evaluate the clinical outcomes of surgical fixation for radial meniscus tears by means of the reinforced suture bar repair technique. The hypothesis was that the rebar repair would improve clinical outcomes in terms of meniscus strength and function.

METHODS: The Rebar Repair was performed on 20 consecutive patients with a minimum of 12-month follow-up. The Rebar Repair is an arthroscopic reinforced suture repair with four separate sutures. Two parallel vertical sutures are first placed on each side of the radial tear, then two additional sutures are placed perpendicular to the tear, juxtaposed to the vertical reinforcing sutures. This technique was done as an inside-out technique by situating knots outside of the meniscus. Lysholm scores, IKDC scores, and Tegner scale were collected post operatively at periods up to one year.

RESULTS: Presurgical and postoperative scores were recorded for all 20 patients for pain, IKDC, Lysholm, and Tegner scale. Pain scores improved from 5.75 to 0.56 at one-year follow-up ($p < 0.0001$). The IKDC score improved from 40.7 pre-injury to 85.7 postoperative ($p < 0.0001$). The Lysholm score improved from 50.7 to 91.9 ($p < 0.0001$). The preoperative Tegner scale improved from 1.7 to 5 ($p = 0.0002$). The pre-injury Tegner scale was 6.5 compared to 5 at the final follow-up which was not statistically different ($p = 0.87$).

CONCLUSIONS: The Rebar Repair technique for radial meniscus tears demonstrated significant improvement in patient outcomes in both pain and function at the one-year follow-up. All patients in the study had improved pain, IKDC, Lysholm, and Tegner activity scores when compared to their presurgical numbers. This technique displays a successful method of repair to salvage the native meniscus.

Paper 238

Analysis of Isolated Medial Meniscus Root Tears: Risk Factors for Clinical Failures

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PURPOSE: To describe a cohort of isolated medial meniscus posterior root tears (MMPRT) and determine short-term clinical outcomes to 1) determine risk factors associated with clinical failures and 2) describe the surgical failure rate in this patient population.

METHODS: Isolated medial meniscus root repairs performed between 2010 and 2019 at a single academic institution were reviewed, with patients with less than 1-year follow-up excluded. Clinical failure was defined as patients with International Knee Documentation Committee (IKDC) scores which were below the Patient Acceptable Symptomatic State (PASS) threshold of 75.9. Additionally, pre-MMPRT and final Tegner activity level, pre- and postoperative Visual Analog Scale (VAS, at rest and with activity) were recorded. Surgical failure was defined as root repair re-tear and conversion to arthroplasty.

RESULTS: Fifty-one isolated medial meniscus root repairs (35 F, 16 M, age: 46 ± 12 , BMI: 31 ± 7) were followed for a of 3.1 years (range: 1.2 – 6.5 years). Mean pre-MMPRT Tegner was 5.1 ± 1.7 and mean preoperative VAS was 4.0 ± 2.7 at rest and 6.0 ± 2.6 with use. Meniscus extrusion on preoperative MRI was 3.5 ± 0.9 mm (range: 1.5 – 5.3). Intraoperatively, 39 patients (76%) were noted to have Outerbridge grade 1+ changes of the medial compartment and 18 (35%) were noted to have Outerbridge grade 1+ changes of the lateral compartment. Patients with a clear acute injury event (HR: 0.39, 95% CI: 0.18 - 0.85, $p = 0.02$), < 4 mm of extrusion (HR: 2.6 for ≥ 4 mm extrusion, 95% CI: 1.09 - 6.22, $p = 0.03$), and preoperative Tegner ≥ 4 (HR: 0.12, 95% CI: 0.02 - 0.63, $p = 0.12$) were more likely to meet the IKDC-PASS threshold of 75.9. Two patients (4%) experienced a root repair re-tear, and two patients (4%, including one root re-tear) converted to arthroplasty at a mean of 4.5 years postoperatively.

CONCLUSION: Transtibial repairs of acute, non-extruded (< 4 mm) MMPRTs in active patients (Tegner ≥ 4) is a safe and clinically effective treatment option, regardless of BMI or Outerbridge grade.

Poster 1

Spinal Anesthesia vs. General Anesthesia in Contemporary Revision Total Hip Arthroplasties

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INTRODUCTION: Spinal anesthesia (SA) is increasingly used in complex patient populations including revision total hip arthroplasties (THAs). However, the benefits of SA vs. general endotracheal anesthesia (GETA) in this population remain unclear. This study aimed to investigate the pain control, length of stay (LOS), and complications associated with SA vs. GETA in a large single institution series of revision THAs.

METHODS: We retrospectively identified 4,767 revision THAs (4,533 patients) from 2000 to 2016 using our institutional total joint registry. Of these cases, 86% had GETA and 14% had SA. Baseline characteristics between groups were similar with mean age of 66 years, 52% female, and mean BMI of 29 kg/m². Pain was assessed by oral morphine equivalents (OMEs) and the numeric pain scale (NPS). Complications including 30-day and 90-day readmissions were studied. Data were analyzed using an inverse probability of treatment weighted model based on propensity score that accounted for age, sex, BMI, ASA score, Charlson comorbidity index, operative diagnosis, operative time, modular vs. non-modular revisions, septic vs. aseptic revisions, single vs. both component revisions if non-modular, year of surgery, and surgeon utilization of SA. Mean follow-up was 7 years.

RESULTS: Patients treated with SA required fewer postoperative OMEs ($p < 0.001$) and had lower NPS scores ($p < 0.001$). Neuraxial anesthesia had a decreased LOS (4.2 vs. 4.8 days; $p = 0.007$), fewer cases of altered mental status (AMS; OR 3.1, $p = 0.001$), and fewer intensive care unit (ICU) admissions (OR 2.3, $p < 0.001$). No difference was observed in rate of VTE ($p = 0.5$), 30-day readmissions ($p = 0.2$), or 90-day readmissions ($p = 0.4$) between cohorts.

DISCUSSION: SA was associated with lower OME use and reduced LOS in this large cohort of revision THAs. Furthermore, SA was associated with fewer cases of AMS and ICU admission after accounting for numerous patient and operative factors with an inverse probability of treatment weighted model.

SUMMARY: Spinal anesthesia in revision total hip arthroplasties was associated with improved pain control, shorter length of stay, and fewer intensive care unit admissions when an inverse probability of treatment weighted model was used.

Poster 2

Midterm Outcomes Of Hip Arthroscopy In High-Level Athletes Who Did Not Return To Sport For Reasons Unrelated To Their Hip

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BACKGROUND: High-level athletes undergoing hip arthroscopy who do not return to sport (RTS) due to loss of interest, lifestyle changes, graduation, or other reasons unrelated to their hip are often neglected in outcomes studies.

PURPOSE: (1) To report minimum 2- and 5-year outcomes of high-level athletes who did not RTS after hip arthroscopy for reasons unrelated to their hip (T athletes) and (2) to benchmark these findings against a propensity-matched control group of high-level athletes who returned to sport (RTS athletes).

METHODS: Data were retrospectively reviewed for professional, collegiate, and high school athletes between April 2008 and October 2015 who underwent primary hip arthroscopy. Athletes were considered eligible if they did not return to sport for reasons unrelated to their hip such as loss of interest, graduation, or a lifestyle transition (T athletes). Inclusion criteria were preoperative and minimum 5-year postoperative PROs for the modified Harris Hip Score (mHHS), Non-Arthritic Hip Score (NAHS), Hip Outcome Score-Sports Specific Subscale (HOS-SSS), and the Visual Analog Scale (VAS) for pain. Clinical outcomes were assessed using the minimal clinically important difference (MCID) and maximum outcome improvement satisfaction threshold (MOIST). T athletes were then propensity-matched to a control group of high-level athletes who returned to sport after hip arthroscopy (RTS athletes) for comparison.

RESULTS: Twenty-seven T hips (25 patients) were included in the analysis with a mean follow-up time of 38.9 ± 16.8 and 72.1 ± 16.8 months for minimum 2- and 5-year outcomes, respectively. They demonstrated significant improvement in all measured PROs. When compared to a propensity-matched control group of RTS athletes, T athletes demonstrated similar improvement in PROs (mHHS, NAHS and HOS-SSS) and achieved MCID and MOIST at similar rates ($P > .05$) except for MCID for mHHS ($P = .033$).

CONCLUSION: T athletes demonstrated favorable outcomes at minimum 2- and 5-year follow-up. They had similar PROs and rates of achieving MCID for HOS-SSS compared to a propensity-matched control group of high-level athletes who returned to sport.

Poster 3

Outcomes Following Primary Total Hip Arthroplasty With Concomitant Gluteus Medius Repair Using The Direct Anterior Approach

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BACKGROUND: Outcomes following total hip arthroplasty (THA) with concomitant gluteus medius (GM) repair using the direct anterior approach (DAA) are scarce. The primary purpose of this study was to report patient-reported outcome measures (PROMs) with two-year follow-up of patients with osteoarthritis and GM tear who underwent primary THA and GM repair through a DAA. The secondary purpose was to compare these outcomes to a benchmark propensity-matched control group who underwent DAA THA that did not have a GM tear.

METHODS: Data were prospectively collected between January 2015 and October 2018. Patients were eligible if they received a primary THA and GM repair via the DAA and had baseline PROMs with two-year follow-up. Patients were excluded if they had worker's compensation, were unwilling to participate, or underwent an approach other than DAA. PROMs sub-analysis was performed between the abovementioned patients and a propensity-matched to a control group with DAA THA without GM tear.

RESULTS: Fourteen patients were included in the study. All were females, the mean age and body mass index was of 62.7 ± 5.8 years and 30.5 ± 4.6 , respectively. Significant improvement for all PROMs and high rate of achieving the minimal clinically important difference (MCID) at two-year follow-up were reported. All patients were successfully propensity-matched to 28 patients for sex, age, and BMI. Preoperative PROMs between groups were similar. At the two-year time point, both groups reported comparable significant improvement, satisfaction, and MCID achievement.

CONCLUSION: Primary THA with concomitant GM repair using the DAA yielded good functional outcomes and a high achieving MCID rate at two-year follow-up. Based on these results, the DAA can be used safely to address symptomatic GM tears during THA. Further, these outcomes were comparable to a benchmark propensity-matched DDA THA control group without Outcomes Following Primary Total Hip Arthroplasty with Concomitant Gluteus Medius Repair Using the Direct Anterior Approach, with a Sub-Analysis Against a Nested Benchmark Propensity-Matched Control Group without Gluteus Medius Tear.

Poster 4

Depression and Anxiety are Associated with Increased Risk of Infections, Revisions, and Reoperations Following Total Hip Arthroplasty

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INTRODUCTION: Mental health conditions including depression and anxiety are increasingly linked with worse health outcomes in many fields of medicine. Furthermore, there has been a historic lack of attention on these comorbidities within total hip arthroplasty (THA) cohorts. This study aims to define the prevalence of anxiety and/or depression prior to primary and revision THAs, and assess impact on rates of any infection, revision, reoperation, and nonoperative complications.

METHODS: Between 2000–2019, 10,011 THAs (8,701 primaries, 1,310 revisions) were identified in patients (1) from a 27-county network of linked electronic medical records (EMRs) and (2) had THA performed at a single academic center. Depression and anxiety were determined from either (1) diagnoses in the EMRs or (2) through an artificial intelligence natural language processing program that identified medications used for depression or anxiety, which underwent subsequent manual chart review validation. Patients with mental health diagnoses other than depression/anxiety were excluded. Mean age was 69 years, mean BMI was 31 kg/m², 55% were female, and mean follow-up was 5 years.

RESULTS: Depression and/or anxiety was common prior to THA, with a prevalence of 30% in primary THAs and 33% in revision THAs. Among primary THA patients with depression and/or anxiety, the risk of any infection (HR = 1.5), revision (HR = 1.7), reoperation (HR = 1.6), and nonoperative complications (HR = 1.3) were all significantly increased ($p < 0.001$). This was more pronounced in revision THA with increased risk of any infection (HR = 1.9), revision (HR = 2), and reoperation (HR = 2.2) (all $p < 0.001$).

CONCLUSION: Presence of depression or anxiety prior to THA is common and associated with higher risk of infection, revision, reoperation, and nonoperative complications that is approximately 1.5-fold higher in primary THA and 2-fold in revision THA. This topic deserves further study, and surgeons may consider mental health optimization of similar importance to preoperative variables such as diabetes control prior to THA.

Poster 5

Complications Following Same-Day vs Inpatient Total Joint Arthroplasty: An Updated Analysis of a National Database

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INTRODUCTION: The proportion of patients being discharged on the day of hip and knee arthroplasties has increased substantially. The purpose of this study is to provide an updated comparison of readmission rates and postoperative complications in matched cohorts of patients who underwent same-day and inpatient hip or knee arthroplasty.

METHODS: Patients who underwent primary elective total hip arthroplasty (THA), total knee arthroplasty (TKA), or unicompartmental knee arthroplasty (UKA) from 2005-2019 were identified in the National Surgical Quality Improvement Program registry. Patients discharged the day of surgery were matched 1:1 to patients who had an inpatient stay using propensity scores. Adverse events, readmissions, and reoperation rates within 30 days were compared.

RESULTS: Of 261,388 patients identified, 2,418 (0.93%) underwent a same-day surgical procedure. After matching, inpatient arthroplasty patients had an increased readmission rate compared to the same-day cohort (3.34% vs. 2.81%, $p = 0.047$). There was no difference in adverse events or return to the operating room between the two groups. When procedures were assessed individually, inpatient UKA patients had a higher readmission rate (2.73% vs. 1.55%, $p = 0.016$) and return to the operating room (0.64% vs. 0.09%, $p = 0.011$) compared to same-day UKA patients. Stepwise multivariate regression revealed age >85 years ($p < .001$), ASA >3 ($p = .033$), hypertension ($p < .001$), and smoking ($p = .025$) as independent risk factors for readmission amongst the entire cohort. Infection was the most common reason for reoperation (12.9%) and readmission (13.2%) following same-day procedures.

CONCLUSIONS: Overall rates of adverse events were similar between inpatient and same-day arthroplasty, however, inpatient arthroplasty is associated with a higher rate of 30-day readmission compared to same-day procedures. Same-day UKA was associated with lower readmission and reoperation rates compared to inpatient UKA. These results suggest that same-day arthroplasty has a similar or slightly improved safety profile compared to inpatient arthroplasty.

Poster 6

The Impact of Resident Involvement on Patient Outcomes in Revision Total Hip Arthroplasty

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INTRODUCTION: The number of revision total hip arthroplasty (THA) procedures in the United States is steadily increasing in concert with the increase in primary total hip arthroplasties. Revision total hip arthroplasty surgeries carry added complications from altered local anatomy, implant migration and failure, or infection. It is important that residents are involved in these complex cases to acquire specific competencies and progress in their education. The aim of this study was to determine the influence of resident involvement on complication rates in revision total hip arthroplasty.

MATERIALS & METHODS: Using the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database, 1,743 revision THAs were identified from 2008-2012; 794 of them involved a resident physician. Demographic information including gender and race, comorbidities including lung disease, heart disease, and diabetes, postoperative complications, operative times, and length of stay were analyzed.

RESULTS: Resident involvement was not associated with a significant increase in the risk of complications. Complications included graft/prosthesis/flap failure, surgical site infection, wound dehiscence, reoperation, pneumonia, unplanned intubation, deep vein thrombosis (DVT), pulmonary embolism (PE), ventilation greater than 48 hours, renal insufficiency, acute renal failure, urinary tract infection (UTI), stroke/cerebrovascular accident (CVA), peripheral nerve injury, cardiac arrest, and myocardial infarction. Total operative time demonstrated a statistically significant association with the involvement of a resident (161.35 minutes with resident present, 135.07 minutes without resident, $p < 0.001$). There was no evidence that resident involvement was associated with a longer length of hospital stay (5.61 days with resident present, 5.22 days without resident, $p = 0.46$).

CONCLUSION: There was no evidence of a significant association between risk of complication and resident involvement during revision THA, despite a statistically significant increase in operation time.

Poster 7

Workers' Compensation Patients Improve After Hip Arthroscopy For Labral Tears

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BACKGROUND: The workers' compensation (WC) status has been associated to inferior outcomes in orthopedic procedures and are usually excluded from clinical outcomes studies.

PURPOSE: (1) to determine outcomes of patients with workers compensation (WC) claims treated with hip arthroscopy for labral tears at minimum five-year follow-up and (2) to compare these findings with a propensity-score matched control group without WC claims.

METHODS: Data were retrospectively reviewed for all patients undergoing hip arthroscopy. Patients were included if they received primary hip arthroscopy, had a WC claim, and had preoperative and minimum five-year follow-up patient reported outcomes (PROs) for the modified Harris Hip Score (mHHS), Non-arthritic Hip Score (NAHS), Hip Outcome Score-Sports Specific Subscale (HOS-SSS) and Visual Analog Scale (VAS) for pain. Exclusion criteria were previous ipsilateral hip conditions, prior hip arthroscopy, and Tönnis Grade > 1. Clinical outcomes were measured using the patient acceptable symptomatic state (PASS), minimum clinically important difference (MCID), and maximum outcome improvement satisfaction threshold (MOIST). Patients were propensity score-matched to a control group without WC claims.

RESULTS: One-hundred eleven out of 132 (84.1%) eligible WC cases met the inclusion criteria with an average follow-up time of 80.3 ± 37.3 months. WC cases demonstrated significant improvement from preoperative to minimum five-year follow-up for mHHS, NAHS, HOS-SSS and VAS for pain ($P < .05$). When compared to a propensity-matched control group (221 patients), the WC group demonstrated lower pre- and postoperative PROs ($P < .05$), however, WC cases had greater magnitude of improvement [Δ mHHS: 23.0 ± 18.3 control vs. 32.7 ± 21.4 WC ($P = .0012$); Δ NAHS: 24.0 ± 20.2 control vs. 35.5 ± 24.5 WC ($P = < .001$), Δ HOS-SSSS: 32.9 ± 29.9 control vs. 45.8 ± 32.2 WC ($p = .012$)]. Significant differences were found between both groups in rates of achieving PASS for the mHHS, HOS-SSS, and iHOT-12, but rates of achieving MCID and MOIST were similar between groups ($P > .05$).

CONCLUSION: Patients with WC claims treated with hip arthroscopy surgery show significant improvement and high rates of returning to light or regular work at minimum five-year follow-up. When compared to a propensity-matched group of not WC cases, they had lower rates of achieving PASS but comparable rates of achieving MCID and MOIST rates. WC patients had greater magnitude of improvement from preoperative to minimum five-year follow-up, proving hip arthroscopy an effective treatment for labral tears regardless of WC status.

Poster 8

Comparable Minimum Five-Year Outcomes Using Either Hamstring Allograft Or Autograft For Acetabular Labral Reconstruction Autograft

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PURPOSE: To compare minimum five-year patient-reported outcome scores (PROs) among patients who underwent primary labral segmental reconstruction with hamstring allograft vs. hamstring autograft, in the setting of femoroacetabular impingement syndrome (FAIS) and irreparable labral tear, using propensity-matched groups.

METHODS: Prospectively collected data were retrospectively reviewed for patients who underwent primary hip arthroscopy from September 2010 to November 2015. Patients were included if they underwent labral reconstruction using hamstring autograft and had preoperative and minimum five-year PROs. Exclusion criteria were previous ipsilateral hip surgery/conditions, hip dysplasia, or Tönnis grade > 1. Patients with autograft labral reconstructions were propensity-matched 1:1 based on age, gender, and body mass index (BMI) to a control group of patients who underwent labral reconstruction using hamstring allograft. Secondary surgeries were reported. The minimal clinically important difference (MCID), and patient acceptable symptomatic state (PASS) were calculated. The P-value for significance was set at < 0.05.

RESULTS: Fifteen patients with autograft hamstring labral reconstructions were propensity-matched to 15 patients with labral reconstruction using allograft hamstring. Propensity-matched groups were similar for gender ($P > .999$), age ($P = .775$), and BMI ($P = .486$). The follow-up time was 80.8 ± 25.5 and 66.1 ± 8.3 ($P = .223$) for the autograft and the allograft groups, respectively. Baseline PROs, preoperative radiographic measurements, surgical findings, and intraoperative procedures were similar. The propensity-matched groups achieved significant and comparable improvement for all PROs ($P < .0001$), satisfaction ($P = .187$), rate of achieving the MCID and PASS.

CONCLUSION: At minimum five-year follow-up, patients who underwent primary arthroscopic labral reconstruction, in the context of irreparable labra, reported significant improvement and comparable postoperative scores for all PROs, patient satisfaction, MCID, and PASS using either autograft or allograft hamstrings.

LEVEL OF EVIDENCE: Level III, Retrospective Comparative Therapeutic Trial.

Poster 9

Concomitant Treatment Of External Snapping Hip And Femoroacetabular Impingement Syndromes

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PURPOSE: To report minimum two-year patient-reported outcome measures (PROMs) following combined primary arthroscopic and endoscopic surgery for femoroacetabular impingement syndrome (FAIS) and painful external snapping hip (ESH), respectively, and to compare these outcomes to a benchmark FAIS propensity-matched control group without ESH.

METHODS: Data were prospectively collected and retrospectively reviewed on patients who underwent arthroscopic hip surgery between February 2010 and December 2018. Patients were eligible if they were preoperatively diagnosed with FAIS and painful ESH and received a concomitant primary hip arthroscopic and hip endoscopy to address these pathologies. Inclusion criteria were preoperative baseline and minimum two-year follow-up scores for the modified Harris Hip Score (mHHS), Nonarthritic Hip Score (NAHS), and Visual Analog Scale (VAS) for pain. Exclusion criteria were worker's compensation, Tönnis grade >1, or previous hip conditions. A secondary sub-analysis was performed to benchmark these outcomes to a FAIS propensity-matched control group without ESH. The minimal clinically important difference (MCID) and the maximum outcome improvement (MOI) rates were reported.

RESULTS: Thirty hips (28 patients) met the inclusion and exclusion criteria and had minimum two-year follow-up. The mean age was 36.9 years, 86.7 % were female, and the mean body mass index (BMI) was 25.0. ESH was resolved in 100% of patients, and there was significant improvement for all PROMs from baseline to minimum two-years ($P < 0.001$). The minimum two-year PROMs and the high rate of achieving the MCID and MOI thresholds were comparable to the benchmark propensity-matched group.

CONCLUSION: Following concomitant hip arthroscopy and hip endoscopy for the respective treatment of FAIS and painful ESH syndrome, patients demonstrated significant improvement in all PROMs and the rate of resolution of ESH was 100% at minimum two-year follow-up. Moreover, functional outcomes and rates of MCID and MOI achievement were comparable to a FAIS propensity-matched benchmark control group.

LEVEL OF EVIDENCE: Level of evidence, 3. Case-Control Study.

Poster 10

Development of a Machine Learning Model to Reliably Predict Risk of Overnight Stay after Outpatient Hip Arthroscopy

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PURPOSE: Overnight admission following elective outpatient hip arthroscopy has implications on clinical outcomes and cost benefit, yet there are few validated risk calculators for reliable predication of which patients are at risk. The purpose was to develop a machine learning algorithm that can effectively identify patients requiring admission following elective hip arthroscopy.

METHODS: A retrospective review of a prospectively collected surgical outcomes database was performed to identify patients who underwent elective outpatient hip arthroscopy from 2006-2018. Patients admitted overnight postoperatively were identified as those with length of stay of one or more days. Models were generated using random forest (RF), extreme gradient boosting (XGBoost), adaptive boosting (AdaBoost), elastic net penalized logistic regression, and an additional model was produced as a weighted ensemble of the four final algorithms.

RESULTS: Overall, 1,276 patients were included. The median age was 43 years and 64.2% (819) were female. Of the included patients, 109 (8.5%) required an overnight stay following elective outpatient hip arthroscopy. The factors determined most important for identification of candidates for inpatient admission were increasing operative time, general anesthesia, age extremes, male gender, greater BMI, ASA class > 1, and the following preoperative lab values: sodium, platelet count, hematocrit, and leukocyte count. The ensemble model achieved the best performance based on discrimination assessed via internal validation (AUC = 0.71), calibration, and decision curve analysis. The model was integrated into a web-based open-access application able to provide both predictions and explanations.

CONCLUSION: A machine learning algorithm developed based on preoperative features identified increasing operative time, age extremes, greater BMI, sodium, hematocrit, platelets, and leukocyte count as the most important variables. If externally validated in independent populations, the algorithm developed presently could effectively guide preoperative screening to identify patients requiring overnight admission for observation and thus optimize both clinical and economic outcomes following hip arthroscopy.

LEVEL OF EVIDENCE: III, retrospective cohort study.

Poster 11

Malseating of Modular Dual Mobility Liners

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BACKGROUND: Prior studies have identified that malseating of a modular dual mobility liner can occur with previous reported incidences between 5.8% and 16.4%. The purpose of this study was to determine the incidence of malseating in dual mobility implants at our institution, assess for risk factors for liner malseating, and investigate whether liner malseating has any impact on clinical outcomes after surgery.

METHODS: We retrospectively reviewed the radiographs of 239 primary and revision THAs with a modular dual mobility liner. Two independent reviewers assessed radiographs for each patient twice for evidence of malseating with a third observer acting as a tiebreaker. Univariate and multivariable logistic regression analysis was conducted to determine risk factors for malseating with Youden's index used to identify cutoff points. Cohen's kappa test was used to measure inter-observer and intra-observer reliability.

RESULTS: 12 Liners (5.0%) including 8 Stryker (6.8%) and 4 Zimmer-Biomet (3.3%) had radiographic evidence of malseating. Inter-observer reliability was found to be .453 (95% CI .26-.64) suggesting weak inter-rater agreement with strong agreement being greater than 0.8. We found cup size of 50 mm or less to be associated with liner malseating on both univariate ($p = .03$) and multivariable analysis ($p = .04$). Patients with malseated liners appeared to have no associated clinical consequences and none required revision surgery at a mean of 14 months postoperatively (range 1.4 to 99.2 months).

CONCLUSION: The incidence of liner malseating was 5.0% which is similar to other reports. Cup size of 50 mm or smaller was identified as a risk factor for malseating. Surgeons should be aware that malseating can occur and implant design changes or changes in instrumentation should be considered to lower the risk of malseating. Although further follow-up is needed, it remains to be seen if malseating is associated with any clinical consequences.

Poster 12

National Trends in Post-Acute Care Costs Following Total Hip Arthroplasty from 2010-2018

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BACKGROUND: Post-acute care remains a target for episode-of-care cost reduction following total hip arthroplasty (THA). Introduction of Medicare bundled-payment models in 2013 and 2016 has aligned incentives among providers to reduce post-acute care resource utilization. Institution-level studies show increased rates of home discharge with substantial cost savings after adoption of bundled payment models, but national data has yet to be reported. The purpose of this study was to evaluate national trends in post-acute care utilization and costs following primary THA over the last decade.

METHODS: We reviewed a consecutive series of 189,847 patients undergoing primary THA during 2010-2018 from the PearlDiver database. Annual trends in patient demographics, discharge disposition, and post-acute care resource utilization were evaluated. Post-acute care reimbursements were standardized to 2020 dollars and included outpatient visits, prescriptions, physical therapy, home health, inpatient rehabilitation, skilled nursing facilities, and any readmissions or emergency department (ED) visits within 90 days of surgery.

RESULTS: From 2010-2018, discharge rates to home under self-care increased (18% vs. 41%, $p < 0.001$), whereas discharge to home with home health (41% vs. 35%, $p = 0.002$), skilled nursing facilities (30% vs. 16%, $p < 0.001$), and inpatient rehabilitation (11% vs. 8%, $p = 0.004$) all decreased. The rate of ED visits (19% vs. 10%, $p < 0.001$) and readmissions (4% vs. 3%, $p = 0.005$) also decreased. Between 2010 and 2018, the mean episode-of-care cost (\$31,562 vs. \$24,188, $p < 0.001$) and mean post-acute care cost (\$5,903 vs. \$3,485, $p < 0.001$) both declined. Post-acute care savings were primarily driven by reduced costs of skilled nursing facilities (\$1,533 vs. \$627, $p < 0.001$), home health (\$1,041 vs. \$763, $p = 0.002$), inpatient rehabilitation (\$949 vs. \$552, $p < 0.001$), ED visits (\$508 vs. \$102, $p < 0.001$), and readmissions (\$367 vs. \$179, $p < 0.001$). Post-acute care costs declined by \$578 ($p = 0.025$) during 2010-2012, \$768 ($p = 0.038$) during 2013-2015, and \$884 ($p = 0.020$) during 2016-2018.

CONCLUSION: Over the last decade, the rate of home discharge after THA increased while readmission and ED visit rates declined, resulting in a substantial decrease in total and post-acute care costs. Post-acute care costs declined most rapidly after the introduction of new Medicare bundled-payment programs in 2013 and 2016.

Poster 13

Femoral Head Decompression for Osteonecrosis with Concurrent Contralateral Total Hip Arthroplasty

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INTRODUCTION: Patients who present with bilateral osteonecrosis of the femoral head (ONFH) in differing stages present a unique challenge to surgeons. There is limited information on outcomes of unilateral femoral head decompression at the time of contralateral total hip arthroplasty (THA).

METHODS: 24 patients underwent hip decompression for early stage ONFH (Steinberg 2 or lower) with concurrent contralateral total hip arthroplasty (THA) for femoral head collapse. Mean age was 40 years and 66% of patients were male. Mean BMI was 29 kg/m². Average follow-up from index THA was 3.5 years (range 2 – 156 months). Preoperatively, 6 patients had no pain on the decompression side. Failure of the decompression was considered if pain persisted or there was progression to collapse. Lesions were measured by Kerboul method. Risk factors for progression to arthroplasty such as lesion size, degree of symptoms, and persistence of risk factors were evaluated.

RESULTS: Ten of 24 hips (42%) required conversion to hip arthroplasty at an average of 10 months (range 2 to 35 months): 5 had progression to collapse and 5 had persistent or new pain without collapse. Hips that underwent arthroplasty had significantly larger lesions (mean 130° vs. 235°, $p = 0.002$). Mean follow-up for preserved hips was 25 months (range 2 – 115 months). Severity of pain at presentation or persistence of risk factors were not associated with need for hip arthroplasty.

CONCLUSION: Hip decompression for pre-collapse ONFH at the time of contralateral THA was associated with preservation of the femoral in roughly half of cases. Larger lesions were associated with conversion to hip arthroplasty. Patients with progressive collapse or worsening pain were converted on average within a year to arthroplasty.

Poster 14

Conversion Total Hip Arthroplasty Following Previous Hip Fractures: A 10 Year Single Institution Experience.

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INTRODUCTION: This study seeks to evaluate the clinical outcomes of a consecutive series of conversion total hip arthroplasty (cTHA) following previous hip fractures.

METHODS: A retrospective chart review of patients who underwent cTHA due to failed fixation of femoral neck, femoral shaft, or intertrochanteric fracture from 2008-2017 at an urban academic teaching institution was performed.

RESULTS: Eighty-eight patients were included in this study. Mean age at the cTHA was 66 years (range 27 to 89). Women consisted 67% of the patients. Mean BMI was 28 kg/m² (range 17 to 41). The mean Charlson Comorbidity index was 3 (range 0 to 9). The mean follow-up was 49 months (range 24 to 131). The mean duration from hip fracture fixation to cTHA was 51 months (range 10 to 144). The mean operating time was 188 minutes, (range 71 to 423) with a mean estimated blood loss of 780 ml (range 300 to 2500). With regard to the implant selection, revision-type (long-stem) designs were used in 66% of the cases. The mean length of hospital stay was 8 days (range 2 to 61). The readmission rate was 23% within 90 days, 79% of which were due to non-orthopedic complications. There were 8 orthopedic complications: 6 wound infections, all of which required I&D and 3 required staged revision. There were 2 dislocations treated with closed reduction. There was no revision for aseptic loosening within the follow-up period. The one-year mortality rate was 0%.

CONCLUSION: Our data corroborates the results of prior studies examining cTHA. The cTHA procedure is associated with longer operating time, more blood loss, longer length of hospital stay, and higher readmission rates than primary total hip arthroplasty. Further refinement of multi-disciplinary care protocols to optimize these patients is needed to curb readmissions and costs of managing this patient population.

Poster 15

Conversion Total Hip Arthroplasty Following Failure of Intertrochanteric Fracture Fixation-A Systematic Review

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INTRODUCTION: The incidence of intertrochanteric hip fractures (ITFx) has increased with the aging population. When ITFx fixation fails, or post-traumatic arthritis develops, conversion total hip arthroplasty (cTHA) is often performed. The purpose of this systematic review is to characterize the modes of ITFx fixation failure, the outcomes and complications following subsequent cTHA.

METHODS: Using the PRISMA guidelines, we did a query of the English language literature in PubMed, Google Scholar, and Web of Science databases. We reviewed the reports published in the last decade (2010 to 2020) that had a minimum of 24 months of follow-up.

RESULTS: Sixteen papers met the screening criteria. There were 1,797 patients. 51.5% of the patients were females. The mean age was 71.4 years with a mean BMI of 25.9 kg/m². The mean Charlson Comorbidity index (CCI) was 1.7 and the mean time from the ITFx fixation to the cTHA was 9.8 months. The top 3 modes of failure were: 1) fixation failure seen in 46.3%, 2) nonunion seen in 19.4%, and 3) implant failure seen in 14.8% of the patients. The mean pre-cTHA Harris Hip Score (HHS) was 40. The mean blood loss during cTHA was 639 ml, and the mean operative time for the cTHA was 138 minutes. The mean post-cTHA follow-up was 46.6 months. The mean post-cTHA Harris Hip score was 84.3. Orthopedic complications occurred in 22.3% of patients. The most common was perioperative fracture (7.5%). The rate of reoperation was 3.3%. The rate of medical complications was 7.3%. The one-year mortality rate was 0.7%.

CONCLUSION: The most common reason leading to cTHA following iITFx was fixation failure and fracture nonunion or collapse (89%). This underscores the importance of further improvement of the surgical techniques in treating ITFx. Similarly, improvements in the surgical techniques of cTHA are needed to reduce the orthopedic complications (22.3%).

Poster 16

Operative Room Time Comparison between General and Spinal Anesthesia in Total Hip Arthroplasty

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INTRODUCTION: A relatively high expense with any procedure is total operative time. Two components of this time are the time spent anesthetizing the patient and time spent removing the patient from the operating room (OR) after surgery. This time can be affected by using spinal anesthesia (SA) or general anesthesia (GA). Currently there is conflicting information about the cost burden of these two techniques in total hip arthroplasty (THA) procedures. This study compares the total time it takes for a patient to be anesthetized and the time until the patient is out of the room, for both spinal anesthesia and general anesthesia, in patients undergoing a primary THA.

MATERIALS & METHODS: A retrospective chart review was performed at a single institution between the years of 2016-2018. Primary THAs without additional complications performed by one surgeon were selected. The anesthesia note from the procedure was reviewed to calculate total time spent anesthetizing the patient and time spent removing the patient from the OR after surgery. Anesthesia records for 40 patients were used; 20 patients who received SA and 20 that received GA.

RESULTS: The time for a patient to be anesthetized was 48.1 minutes in the GA group and 58.6 minutes in the SA group ($p = 0.0013$). The time spent moving the patient from the operating after surgery was 6.8 minutes in the GA group and 4.4 minutes in the SA group ($p = 0.0015$). When combining these times, the total time of anesthesiologist involvement pre and postoperatively was 54.9 minutes in the GA group and 63.1 minutes in the SA group ($p = 0.0154$).

CONCLUSION: There was a significant difference in the total time of anesthesiologist involvement in general anesthesia vs. spinal anesthesia groups. The total time of anesthesiologist involvement was significantly lower for patients receiving general anesthesia. This and the complications of both GA and SA should be taken into consideration when anesthetizing patients undergoing THA.

Poster 17

Higher Postoperative Risks in HIV Patients After Total Joint Arthroplasty

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INTRODUCTION: Life expectancy in the HIV population has dramatically increased in the past decade due to improved treatment. This has resulted in an increase in joint reconstruction surgeries done in these immunosuppressed patients. These patients may still be higher risk surgical candidates even with improved HIV therapies.

METHODS: A retrospective chart review was performed spanning a four-year period. 55 joint procedures were performed in 42 patients diagnosed with HIV including 13 TKA, 4 knee revisions, and 38 THA. Pre- and postoperative CD4 count and viral loads were recorded along with duration of HAART therapy and postoperative complications.

RESULTS: Three patients (5.4%) in our cohort developed postoperative infections at an average of four weeks postoperative. All three had a history of IVDU. Two of these patients resolved with IV antibiotics while one underwent debridement. We did not find any correlation between history of preoperative soft tissue, viral load, or CD4 count to postoperative infection.

CONCLUSION: Various studies have shown that HIV patients are at a higher risk for deep tissue infection. Many of these studies however are older and may not take into account the widespread use of modern HAART. Our results show that compliance with HAART has vastly improved the outcomes of arthroplasty in these patients, while a history of IVDU is the largest independent risk factor for infection in this population.

Poster 18

The Safety of Total Hip Arthroplasty in a Free-Standing Ambulatory Surgery Center in Obese Patients

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INTRODUCTION: Total hip arthroplasty (THA) is increasingly performed as an outpatient procedure, specifically in the free-standing ambulatory surgery center (ASC) setting. This study evaluated the safety of outpatient THA with planned same-day discharge (SDD) in patients with a body mass index (BMI) of 35 or greater.

METHODS: A retrospective review of patients undergoing primary THA in two free-standing ASCs from June 2013 to June 2020 was performed. All patients with BMI of 35 or greater were included. Patients were evaluated for preoperative and demographic variables, day-of-surgery and intraoperative variables, and postoperative complications. Facility duration, time to postoperative ambulation, and postoperative facility duration were recorded. A Shapiro-Wilk test was used to evaluate the normality of facility times, and they were not normally distributed ($p < 0.001$), thus the median duration and interquartile range (IQR) was used. Postoperative evaluation included reoperations, readmissions, and emergency department (ED) visits during the 90-day global period.

RESULTS: Two hundred two patients were included. Average age and BMI were 55.4 ± 8.1 and 37.6 ± 2.0 , respectively. Patients had 2.4 ± 1.5 comorbidities, with the most common being hypertension (137, 68%). Forty-seven patients had obstructive sleep apnea (23%). Seven patients were ASA Class 1, 121 were Class 2, and 74 were Class 3. One intraoperative complication of fracture was noted, and one patient required an indwelling Foley catheter for urinary retention. Total facility duration was 8 hours, 5 minutes (8:05) (IQR 7:04, 9:29), time to postoperative ambulation was 3:18 (IQR 2:29, 4:10), and postoperative facility duration was 4:23 (IQR 3:21, 5:42). One patient underwent next day discharge due to provider preference, but all others underwent SDD. Five patients (3%) had postoperative complications—2 surgical site infections, 2 dislocations, and 1 periprosthetic fracture. Four patients each (2%) required reoperation, readmission, and an ED visit.

CONCLUSION: Appropriately selected patients with a BMI over 35 may safely undergo THA in a free-standing ASC with reliable SDD and acceptable complication profiles.

Poster 19

PLAN and AM-PAC "6-Clicks" Scores to Predict Discharge Disposition after Primary Hip Arthroplasty

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BACKGROUND: The determination of appropriate post-acute care disposition after total hip arthroplasty (THA) is a multidisciplinary decision. Efficient post-acute care management has been identified as an opportunity to improve value for patients and algorithms have been designed pre- and postoperatively to optimize such decision. The purpose of this study was to evaluate the predictive ability of two such tools, including the (1) preoperatively administered Predicting Location after Arthroplasty Nomogram (PLAN) and (2) postoperatively administered Activity Measure for Post-Acute Care [AM-PAC] '6- Clicks' Basic Mobility tools, in accurately determining discharge disposition and readmission after elective THA.

METHODS: Between December 2016 and March 2020, 3,761 patients underwent THA at a tertiary academic center. PLAN and '6- Clicks' Basic Mobility scores were recorded for all patients. Regression models and receiver operator characteristic curves were constructed to evaluate the tools' prediction concordance with the actual discharge disposition (home vs. facility).

RESULTS: Preoperative PLAN and postoperative '6-Clicks' Basic Mobility scores are good to excellent predictors of discharge disposition after primary THA. PLAN scores had a concordance index of 0.750 for THA. The '6-Clicks' Basic Mobility score had a concordance index of 0.812. A higher sensitivity was observed for the PLAN score (0.747), while a higher specificity was observed for the '6-Clicks' first mobility score (0.882). When PLAN and '6-Clicks' agreed on home discharge, higher rates of discharge to home (97.8%) and lower readmission rates (4.8%) were observed, compared to when the tools disagreed.

CONCLUSION: Both PLAN and '6-Clicks' Basic Mobility scores afforded marked predictive value in post-acute care course of management; thereby providing value to THA patients. Their corresponding utilities suggest that both preoperative and postoperative variables influence discharge disposition. We recommend that preoperative variables should be collected and used to generate a tentative plan for discharge, and the final decision on discharge disposition should be augmented by early postoperative evaluation.

Poster 20

Spinal Anesthesia vs. General Anesthesia in Contemporary Revision Total Knee Arthroplasties

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INTRODUCTION: Spinal anesthesia (SA) is increasingly used in revision total knee arthroplasties (TKAs). However, the advantages of SA over general endotracheal anesthesia (GETA) require further evaluation. This study aimed to investigate the pain control, length of stay (LOS), and complications associated with SA vs. GETA in a large single institution series of revision TKAs.

METHODS: We identified 3,711 revision TKAs (3,495 patients) from 2000 to 2016 using our institutional total joint registry. 66% had GETA and 34% had SA. Mean age, sex distribution, and mean BMI were similar between groups at 67 years, 47% female, and 32 kg/m², respectively. Pain was assessed by oral morphine equivalents (OMEs) and the numeric pain scale (NPS) score. Complications including 30-day and 90-day readmissions were studied. Data were analyzed using an inverse probability of treatment weighted model based on propensity score that accounted for age, sex, BMI, ASA score, Charlson comorbidity index, operative diagnosis, operative time, modular vs. non-modular revisions, septic vs. aseptic revisions, single vs. both component revision if non-modular, year of surgery, and surgeon utilization of SA. Mean follow-up was six years.

RESULTS: Patients treated with SA required fewer postoperative OMEs ($p < 0.0001$) and had lower NPS scores ($p < 0.001$). SA was associated with shorter LOS (4.0 vs. 4.6 days; $p < 0.0001$), fewer cases of altered mental status (AMS; OR 2.0, $p = 0.004$), and fewer ICU admissions (OR 1.7, $p = 0.02$). There was no difference in the incidence of VTE ($p = 0.82$), reoperation for infection ($p = 0.97$), 30-day readmissions ($p = 0.06$), or 90-day readmissions ($p = 0.18$) between anesthetic techniques.

DISCUSSION: We found SA for revision TKAs was associated with significantly lower pain scores, reduced OME requirements, and decreased LOS. Furthermore, SA was associated with fewer cases of AMS and ICU admissions even after accounting for numerous patient and operative factors with an inverse probability of treatment weighted model.

SUMMARY: Spinal anesthesia in revision TKAs was associated with improved pain control, shorter length of stay, and fewer ICU admissions when an inverse probability of treatment weighted model was used.

Poster 21

Tensile Properties of Tendon After Repair Using Implants with Different Porosities in a Rat Model

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INTRODUCTION: Extensor mechanism reconstruction associated with knee arthroplasty is problematic. Having a tendon grow into a metal implant has great advantages for reconstruction. With the introduction of porous metal implants, it was hoped that tendons could be directly attached to the implants. However, the effects of the porous metal structure on tissue growth and cellular penetration onto the pores is unknown. In this rat model, we investigated the effect of pore size on tendon repair fixation strength using printed titanium implants.

METHODS: Fourteen Sprague Dawley rats were divided into four groups: control (n = 2) and implants with pore sizes of 400µm (n = 4), 700µm (n = 4), and 1000µm (n = 4). A defect was created in the Achilles tendon and the implant positioned between cut ends and secured with suture. Specimens were harvested at twelve weeks and subjected to tensile mechanical load to failure testing.

RESULTS: Average load to failure was 72.6N for controls (SD 10.04), 29.95N for 400µm (SD 17.95), 55.08N for 700µm (SD 13.47), and 63.08N for 1000µm (SD 1.87). Significant differences were found between control vs. 400µm (p = 0.04) and 400µm vs. 1000µm (p = 0.01), while 400µm vs. 700µm approached statistical significance (p = 0.07). No differences were found between control vs. 700µm (p = 0.19), control vs. 1000µm (p = 0.11), or 700µm vs. 1000µm (p = 0.28). The load to failure was generally better in the larger pore sizes.

CONCLUSION: Printing titanium implants allows for precise determination of pore size and structure. Our results showed that tendon repair utilizing implants with 700µm and 1000µm pores exhibited similar load to failure as controls. Using defined pore structure at the attachment points of tendons to implants may allow predictable tendon to implant reconstructions at the time of TKA or use of endoprosthesis.

Poster 22

Depression and Anxiety are Associated with Increased Risk of Infections, Revisions, and Reoperations Following Total Knee Arthroplasty

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INTRODUCTION: Mental health conditions including depression and anxiety are increasingly linked with worse health outcomes in many fields of medicine. Furthermore, there has been a historic lack of attention on these comorbidities within total knee arthroplasty (TKA) cohorts. This study aims to define the prevalence of anxiety and/or depression prior to primary and revision TKAs and to assess impact on rates of any infection, revision, reoperation, and nonoperative complications.

METHODS: Between 2000–2019, 11,388 TKAs (10,466 primaries, 922 revisions) were identified in patients (1) from a 27-county network of linked electronic medical records (EMRs) and (2) had TKA performed at a single academic center. Depression and anxiety were determined from either (1) diagnoses in the EMRs or (2) through an artificial intelligence natural language processing program that identified medications used for depression or anxiety, which underwent subsequent manual chart review validation. Patients with mental health diagnoses other than depression or anxiety were excluded. Mean age was 68 years, mean BMI was 33 kg/m², 58% were female, and mean follow-up was 5 years.

RESULTS: Depression and/or anxiety was common prior to TKA, with a prevalence of 32% in primary TKAs and 35% in revision TKAs. Among primary TKA patients with depression and/or anxiety, the risk of any infection (HR = 1.6), revision (HR = 1.6), and reoperation (HR = 1.4) were all significantly increased ($p < 0.001$). Similar associations were observed in revision TKA with increased risk of any infection (HR = 1.8), revision (HR = 1.6), and reoperation (HR = 1.9) (all $p < 0.001$).

CONCLUSION: Presence of depression or anxiety prior to primary or revision TKA is common and associated with an approximately 2-fold higher risk of infection, revision, and reoperation. This topic deserves further study, and surgeons may consider mental health optimization of similar importance to preoperative variables such as diabetes control prior to TKA.

Poster 23

What are the Complications and Costs of Patellofemoral Arthroplasty?

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INTRODUCTION: Patellofemoral arthroplasty (PFA) is an alternative to total knee arthroplasty (TKA) for patellofemoral arthritis. Although PFA offers the potential to preserve native kinematics and accelerate recovery, it may be associated with higher revision rates. The purpose of this study is to utilize a national database to compare complication rates and costs between PFA and TKA.

METHODS: 1,768 Patients with patellofemoral arthritis (identified using ICD9/10 codes for patella chondromalacia while concomitantly excluding patients with a diagnosis of tibiofemoral arthritis) treated with PFA or TKA from 2010-2015 were retrospectively reviewed using the Humana Administrative database with five-year follow-up. A 1:1 stepwise algorithm was utilized to match PFA and TKA patients by age, sex, and Elixhauser comorbidity index. Sociodemographic data, comorbidities, costs, and five-year complications were compared between matched cohorts. The lifetime cost-effectiveness of PFA compared to TKA was evaluated with Markov decision modeling.

RESULTS: Compared to TKA, PFA was associated with a lower rate of ED visits (6.3% vs. 4.2%, $p = 0.021$) but a higher 5-year incidence of revision (9.8% vs. 4.2%, $p < 0.001$). Based on multivariate regression, PFA was independently more likely to undergo revision (odds ratio 2.60, 95% confidence interval 1.32-4.71, $p = 0.003$). PFA and TKA were associated with similar rates of medical complications (11.5% vs. 13.4%, $p = 0.232$) and readmissions (1.2% vs. 1.4%, $p = 0.699$). PF, however, was associated with lower total healthcare costs at every time point between 3 months (\$18,014 vs. \$26,473, $p < 0.001$) and 5 years (\$20,837 vs. \$27,942, $p < 0.001$). On average, the lifetime cost of PFA per patient was \$5,235 less than for TKA (\$26,343 vs. \$31,578, respectively).

CONCLUSIONS: PFA is a less expensive alternative to TKA with a similar medical complication risk, but is associated with a significantly higher five-year revision rate. Future studies should examine the reasons for PFA failure and methods to mitigate this risk.

Poster 24

Minimum One-Year PROMS are Predicted by the Amount of Improvement in PROMS Four-Months after TKA

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BACKGROUND: Traditional predictors of patient-reported outcomes (PROMs) following total knee arthroplasty (TKA) have included demographic variables, disease severity, and other factors. However, early patient improvement itself as a predictor of longer-term PROMs is not well studied. This study compared the strength of early improvements in PROMs as predictors of PROMS at longer-term follow-up relative to traditional predictors.

METHODS: Prospectively collected PROMs for 1,093 primary TKAs consecutively performed at an academic center using consistent medical and rehabilitation protocols were analyzed. The amount of improvement in PROMs from preoperative baseline to 4-month follow-up was entered along with 14 traditional outcome predictors in multivariate analysis of PROM scores at minimum 1-year follow-up. Analysis focused on whether the amount of improvement at 4-months influenced 1-year outcomes in addition to, or in interaction with, traditional predictors.

RESULTS: The cohort was 67% female with mean age and BMI of 66 years and 34 kg/m². The amount of early improvement in Knee Society walking and stair climbing pain and KOOS JR total score had the largest effect of all predictors on minimum 1-year PROMs ($p \leq 0.001$). When improvement in walking pain was ≥ 2.0 points at 4-month follow-up, mean probabilities for achieving minimum 1-year pain with walking scores ≤ 1 (no or mild pain) ranged from 0.60-0.75. When early improvement in stair climbing pain was ≥ 5.0 points, mean probabilities for achieving stair climbing pain scores ≤ 1 at minimum 1-year ranged from 0.52-0.65. Achievement of minimum 1-year KOOS JR scores ≥ 75.0 was most likely when the improvement at 4-months was ≥ 30.0 points (mean probability range 0.65-0.86).

CONCLUSION: The amount of improvement in PROMS 4-months after TKA independently and most strongly predicted PROMS at minimum 1-year follow-up relative to traditional outcome predictors. Patient and clinician expectations for improvement following TKA may best be predicated on early improvements in PROMS.

Poster 25

General versus Neuraxial Anesthesia in Revision Surgery for Periprosthetic Joint Infection

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INTRODUCTION: Neuraxial anesthesia for patients undergoing revision total hip or knee arthroplasty for periprosthetic joint infection (PJI) remains controversial, as there is concern for seeding the cerebrospinal spaces. The current study was thus performed to compare outcomes of revision surgery for PJI performed with general vs. neuraxial anesthesia.

METHODS: Patients undergoing explant or revision hip or knee arthroplasty for PJI were identified in the 2005-2019 American College of Surgeons National Surgical Quality Improvement Program databases. Patient characteristics, comorbidities, procedures, and thirty-day outcomes were compared between cases performed with general and neuraxial (including spinal and epidural) anesthesia. Multivariate analysis controlling for age, sex, body mass index, American Society of Anesthesiologists score, preoperative functional status, and procedure type was then performed.

RESULTS: Among the 8,121 patients included, 2,403 (29.6%) and 5,718 (70.4%) underwent revision hip and knee surgery, respectively. Neuraxial anesthesia was used in 1,435 patients (17.7%) and general in 6,686 patients (82.3%). Compared to general anesthesia, neuraxial anesthesia was associated with lower rates of any adverse event (47.3% vs. 37.7%, $p < 0.001$), major adverse event (27.2% vs. 20.8%, $p < 0.001$), deep surgical site infection (19.4% vs. 15.6%, $p = 0.001$), sepsis (10.0% vs. 5.4%, $p < 0.001$), septic shock (0.72% vs. 0%, $p = 0.002$), minor adverse events (31.0% vs. 23.1%, $p < 0.001$), and blood transfusion (26.1% vs. 17.3%, $p = 0.002$). Readmission and reoperation rates were similar between cohorts. Of the 674 (9.2%) reoperations, 2 had a diagnosis of intraspinal abscess, both occurring after general anesthesia ($p = 0.512$). Among the 912 (12.0%) readmissions, none had a primary diagnosis of intraspinal abscess or meningitis. On multivariate analysis, neuraxial anesthesia was associated with lower rates of any adverse event (odds ratio [OR] 0.73, 95% confidence interval [CI] 0.65-0.83, $p < 0.001$), major adverse events (OR 0.78, CI 0.68-0.91, $p = 0.001$), including deep surgical site infection (OR 0.85, CI 0.73-0.99, $p = 0.044$) and sepsis (OR 0.58, CI 0.46-0.75, $p < 0.001$), and minor adverse events (OR 0.71, CI 0.61-0.81, $p < 0.001$), including blood transfusion (OR 0.61, CI 0.52-0.72, $p < 0.001$).

CONCLUSION: Neuraxial anesthesia is associated with significantly lower 30-day rates of total, major, and minor adverse events when compared to general anesthesia in revision surgery for PJI. We found no evidence to suggest that neuraxial anesthesia increases the risk of intraspinal abscess or meningitis.

Poster 26

Fewer Complications Associated with Outpatient Total Knee Arthroplasty from 2010-2018

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INTRODUCTION: The number of total knee arthroplasties (TKA) performed on an outpatient basis continues to increase. While some studies demonstrate higher patient satisfaction and cost reduction associated with same-day TKA, concerns exist regarding safety. The purpose of this study is to compare complication rates over the last decade to evaluate trends in the safety of outpatient TKA.

METHODS: Patients who underwent TKA during 2010-2018 from the Humana administrative claims database were identified and stratified based on the year of surgery. Outpatient status was defined as discharge on the day of surgery. Propensity score matching was performed based on age, gender, Elixhauser comorbidity index, and year of surgery. Ninety-day adverse events were compared by year of surgery in the matched cohorts using multivariable regression analysis. Linear regression analysis and t-test were used to compare trends from 2010 to 2018.

RESULTS: Of the 837,259 patients in the sample, 31,976 outpatient TKA (3.9%) patients were propensity matched to a similar number of inpatient TKA patients. The incidence of outpatient TKA increased from 2010 to 2018 (3.8% vs. 38.2%, $p < 0.001$). In 2010, there were similar incidences of adverse events (14.6% vs. 13.6%, $p = 0.473$). In 2018, outpatient TKA patients saw fewer complications than inpatient TKA patients (7.0% vs. 8.8%, $p = 0.002$). In 2018, adjusted odds of any complication following outpatient TKA was less than inpatient TKA (OR 0.59, 95% CI 0.55-0.62). From 2010-2018, there were greater declines in rates of urinary tract infection (UTI) ($R^2 = 0.862$, $p = 0.034$), acute kidney injury (AKI) ($R^2 = 0.918$, $p < 0.001$), wound complication ($R^2 = 0.723$, $p = 0.017$), and 'any complication' ($R^2 = 0.957$, $p = 0.002$) in outpatient TKA relative to inpatient TKA.

CONCLUSIONS: The rate of complications in both cohorts declined dramatically suggesting improvements in quality of care over time, with the greatest decline in patients undergoing outpatient procedures. These results suggest that outpatient TKA is just as safe as inpatient procedures.

LEVEL OF EVIDENCE: Prognostic Level III Home Health Care in Medicare-aged Patients Is Associated with increased Early Emergency Visits, Readmissions, and Costs Following Total Knee Arthroplasty.

Poster 27

A Retrospective Review of Relative Value Units in Revision Total Knee Arthroplasty: A Dichotomy Between Surgical Complexity and Reimbursement

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INTRODUCTION: Revision total knee arthroplasties (TKA) are costly, time-intensive, and technically demanding procedures. Currently, there are concerns regarding the valuation of CPT codes and the assigned relative value units (RVU) system for revision procedures. The purpose of this study was to evaluate the labor and time investment for each component-specific revision. We hypothesized that a disparity exists between procedural value billed and final reimbursement in primary and revision TKAs.

METHODS: A retrospective review was performed to identify primary or revision TKAs performed at our institution from 2007-2019. Patients were randomly selected from the following: primary TKA, single femoral component revision, single tibial component revision, polyethylene liner only revision, all component revision, and spacer placement for prosthetic infection. Operative notes were reviewed to adjust for misattributed CPT codes. 163 cases met our inclusion criteria and were studied using internal billing data. Independent T-tests were conducted to compare final reimbursement per minute and per RVU between revision and primary TKAs.

RESULTS: The following procedures were performed: 28-primary TKAs, 11-femoral component revisions, 25-tibial component revisions, 25-liner exchanges, 37-all component (complete) revisions, and 28-spacer placements. With the samples available for this study the reimbursement breakdown is as follows: primary TKAs—\$24.64/min and \$89.74/RVU, femoral revisions—\$20.65/min and \$87.67/RVU, liner exchanges—\$23.82/min and \$49.75/RVU ($p<.05$), tibial component revisions—\$18.90/min ($p<.05$) and \$67.81/RVU ($p<.05$), all component revisions—\$14.57/min ($p<.05$) and \$73.71/RVU, and spacer placement—\$10.05/min ($p<.05$), and \$55.41/RVU ($p<.05$). T-testing compared each revision subgroup to primary TKA.

CONCLUSIONS: Our results demonstrate that as revision complexity increases, physicians are reimbursed less per minute and per RVU compared to primary TKA. In the future physicians will face the choice whether or not to perform revision cases, further supporting the need for a re-evaluation of RVU allocation amongst revision procedures and potential changes to the CPT coding system.

Poster 28

Oral Dexamethasone Decreases Pain and Nausea after Outpatient Total Knee Arthroplasty

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BACKGROUND: Intravenous dexamethasone has been shown to decrease postoperative pain and nausea. However, no studies have evaluated the effect of oral dexamethasone as part of multimodal pain regimen in outpatient total knee arthroplasty. Our study is a prospective, double-blind, randomized controlled trial evaluating the effects of oral dexamethasone on postoperative pain and nausea in outpatient total knee arthroplasty.

METHODS: 114 patients underwent outpatient total knee arthroplasty by the senior author. Patients were randomly assigned to one of three groups: placebo, 4mg oral dexamethasone, and 8mg oral dexamethasone. All patients received medication for five days postoperatively in addition to an identical perioperative protocol. Outcomes included VAS pain and nausea scores, complications, narcotic usage, range of motion, SF-36, KSS, and KSS functional scores.

RESULTS: VAS pain scores were significantly lower in the 4mg dexamethasone group ($p=0.0277$), and the 8mg group showed a trend toward lower pain scores compared to placebo. Patients reported less nausea in the 8 mg dexamethasone group ($p=0.0464$), and the 4mg group showed a trend toward less nausea when compared to placebo. Trend toward decreased opioid consumption in both the 4mg and 8mg dexamethasone groups compared to placebo. The 4mg dexamethasone group had statistically significantly better KSS scores than the other 2 groups ($p=0.0275$). No significant difference in range of motion, SF-36 scores for pain and function, and KSS functional scores. No major complications occurred.

CONCLUSIONS: Addition of oral dexamethasone to a multimodal pain regimen is safe and effective at decreasing pain and nausea in outpatient total knee arthroplasty.

Poster 29

Documented Penicillin Allergies Should Not Preclude Use of Pre-Operative Cefazolin in Hip and Knee Arthroplasty

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INTRODUCTION: Infection after total hip arthroplasty (THA) and total knee arthroplasty (TKA) is a devastating complication and a tremendous burden to patients and the healthcare industry globally. One of the main reasons perioperative cefazolin is avoided, is a documented allergy to penicillin. Cefazolin presents a lower risk to patients overall and offers more specific microbe coverage compared to the recommended alternatives. Given these risk mitigating factors and in the interest of antibiotic stewardship, we decided to investigate whether intra-op administration of IV cefazolin was a viable option.

METHODS: A database search from a single surgeon was performed over a 5-year period, between the years of 2013 and 2017 for all primary and revision total hip and knee arthroplasties. We investigated rates of infection, allergic reactions, and demographics. Frequencies of occurrence were calculated in percent for multiple data points using standard mathematical equations.

RESULTS: A total of 2,451 THA and TKA surgeries were identified. The average age of the patients was 65.7 years of age, with an average BMI of 31.8. Infection rates were 3.4% (12) and 3.6% (73) for those with a penicillin allergy and those without, respectively in our study. Those reporting a cephalosporin allergy reported a higher, 6.9% (6) rate of infection. When cephazolin was used overall the infection rate was 3% (62) compared to 5.8% (18) with other antibiotics. In primary arthroplasty, an infection rate of 1.4% (21), however, other antibiotics were used so infrequently compared to cephazolin, a difference may not be apparent, with those only showing a 0.4% (1) infection rate. The largest impact cephazolin has is on revision surgery, which shows an infection rate of 7.9% (39) vs. 10.9% (19) when other antibiotics are used. Overall allergic reactions to cephazolin administration was extremely low, with only 1 reported, in a patient with a listed IgE mediated reaction. The reaction was not severe, and did not require any additional treatment.

CONCLUSION: In our study, nearly half of patients were given cefazolin with a penicillin allergy, only one patient had an allergic reaction. This study shows that cefazolin has protection against postoperative infection in total joint arthroplasty over clindamycin, the most commonly given alternative when a patient has a penicillin allergy, and that despite penicillin allergy, administration of cefazolin preoperatively is benign and does not pose a risk of adverse reactions.

Poster 30

Preoperative PROMIS-GH and KOOS-JR Scores Predict MCID Achievement Following Total Knee Arthroplasty

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INTRODUCTION: The patient-specific factors influencing postoperative improvement following total knee arthroplasty (TKA) are important considerations for the surgeon and patient. The primary purpose of this study was to determine which patient demographic factors influence the postoperative Patient-Reported Outcomes Measurement Information System (PROMIS) Global Health (GH) scores. Secondly, we aimed to compare the prognostic utility of preoperative PROMIS-GH and Knee Injury and Osteoarthritis Outcome Score for Joint Replacement (KOOS-JR) scores in predicting postoperative improvement.

METHODS: This retrospective cohort study of a consecutive series of primary, unilateral TKA patients analyzed prospectively collected KOOS-JR and PROMIS-GH surveys. PROMIS-GH includes physical health (PH) and mental health scores. Patient demographic and pre-surgical characteristics were evaluated for prognostic capability in predicting postoperative improvement in the PROMIS scores and achievement of minimal clinically important difference (MCID) within one year of surgery. Receiver operating characteristic curves were used to understand the prognostic thresholds of preoperative PROMIS and KOOS-JR scores for predicting MCID achievement.

RESULTS: A total of 872 patients were included. Although unadjusted analyses showed associations between patient demographic factors and PROMIS-PH scores, multivariable regression analysis for predictors of MCID achievement demonstrated that PROMIS-PH was the only significant preoperative variable. Receiver operating characteristic analysis revealed that the area under the curve of PROMIS-PH (0.70, 95% CI 0.67-0.74) was less than that of KOOS-JR (0.77, 95% CI 0.73-0.81; $p = 0.032$). Sensitivity and specificity for achieving MCID were maximized for preoperative PROMIS-PH scores of ≤ 38 (59% and 70%) and for preoperative KOOS-JR scores of ≤ 51 (71% and 69%).

CONCLUSION: Patient-specific demographics and preoperative characteristics do not add prognostic value to preoperative PROMIS Global Health scores when predicting MCID achievement. Both preoperative KOOS-JR and PROMIS Physical Health scores predict clinically meaningful improvement after total knee arthroplasty, but KOOS-JR has greater prognostic utility in the early postoperative.

Poster 31

Patellar Component Positioning in Total Knee Arthroplasty

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INTRODUCTION: Patellofemoral complications occur in up to 10% of total knee arthroplasty (TKA) cases and are the most common cause of revision procedures. Among other factors, the position of the patellar component plays a critical role in patellar tracking. The purpose of this study is to review the current literature regarding placement of the patellar button, and to utilize a cadaver model to investigate alterations in tracking with variations in implant location.

METHODS: Six fresh frozen cadaver knees were prepared using traditional total condylar knee arthroplasty technique with polyethylene dome patellar components. The patellar implant was placed in three different positions: medially, centrally, and laterally. For each location, one small and one optimally sized patellar component was used. Patellar tracking was observed and assessed using radiographic images taken at different degrees of passive flexion. A Pubmed search was conducted for a narrative review of the literature.

RESULTS: The medially-placed, small patellar component demonstrated the greatest amount of lateral tilt and maltracking, while the centrally-placed, optimum-sized patellar component tracked best. When placed medially, the optimum-sized implant demonstrated poor tracking, but with a lesser degree of medial lift than the small implant. When placed laterally, both the optimally-sized and small components demonstrated poor tracking.

CONCLUSION: Optimal tracking of the patella following total knee arthroplasty can best be achieved with central placement of an optimally-sized patellar implant. Literature to date has demonstrated conflicting results with no definitive guidelines. From this study, it is believed that an optimally-sized, centrally-placed implant is best for patellar tracking.

Poster 32

Operative Room Time Comparison between General and Spinal Anesthesia in Total Knee Arthroplasty

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BACKGROUND: More than 600,000 total knee arthroplasty (TKA) procedures are performed in the United States yearly. These numbers are largely attributed to the overall high patient satisfaction with the surgery. As the popularity of this procedure continues to rise, it is important to try to reduce costs while maintaining patient safety. Currently there is conflicting information about the cost burden of general anesthesia (GA) and spinal anesthesia (SA) techniques. This study compares the total time it takes for a patient to be anesthetized and the time until the patient is out of the room post-surgery, for both general anesthesia and spinal anesthesia, in patients undergoing a primary TKA.

MATERIALS & METHODS: A retrospective chart review was performed at a single institution between the years of 2016-2018. Primary TKAs without additional complications performed by one surgeon were selected. The anesthesia note from the procedure was reviewed to calculate total time spent anesthetizing the patient and time spent removing the patient from the OR after surgery. Anesthesia records of 40 patients were included, 20 that received SA and 20 that received GA.

RESULTS: The total time for a patient to be anesthetized was 18.5 minutes in the GA group and 22.7 minutes in the SA group ($p = 0.210$). The time spent moving the patient from the operating room after surgery was 7.25 minutes in the GA group and 4.35 minutes in the SA group ($p = 0.0003$). When combining these times, the total time of anesthesiologist involvement pre- and postoperatively was 25.8 minutes in the GA group and 27.1 minutes in the SA group ($p = 0.694$).

CONCLUSION: There is no significant difference in the time of anesthesiologist involvement when comparing GA to SA in primary TKA. Therefore, more emphasis should be placed on the complications or lack thereof when considering anesthetic technique for patients undergoing TKA.

Poster 33

Comparative Analysis of Topical Versus Intravenous Administration of Epsilon-Aminocaproic Acid on Blood Management in Total Knee Arthroplasty

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BACKGROUND: Although the use of antifibrinolytics to reduce perioperative blood loss during total knee arthroplasty (TKA) has shown unequivocal benefit in regard to blood conservation, the best route of administration remains in question. We tested the hypothesis that topical delivery of epsilon-aminocaproic acid (EACA) was superior to intravenous (IV) administration in the setting of primary TKA.

METHODS: This cross-sectional study included a six-year retrospective chart review of TKA patients done by a single fellowship-trained surgeon. We compared postoperative hemoglobin levels and the incidence of blood transfusions among three patient subgroups: no EACA, topical EACA, or IV EACA. Key outcome measures included postoperative hemoglobin, need for postoperative transfusion, and length of hospital stay.

RESULTS: Of the 668 patients included in this study, 351 (52.5%) received IV EACA, 298 (44.6%) received topical EACA, and 19 (2.8%) received no EACA. For the 3-way comparisons, significant differences were observed for postoperative mean hemoglobin on day 1 ($p < 0.001$), day 2 ($p < 0.001$), and day 3 ($p = 0.004$) with consistently higher means for participants in the topical group. Eight patients required transfusion in the IV EACA group, but none were needed in the topical EACA group ($p = 0.027$). Length of stay was shortest for patients in the topical group with 66% staying hospitalized for two days, while 84% of the IV group remained hospitalized for three days ($p < 0.001$).

CONCLUSION: The topical delivery of EACA is superior to IV administration with respect to blood conservation for patients undergoing primary TKA.

Poster 34

Who Is Still Receiving Blood Transfusions After Primary and Revision Total Knee Arthroplasty?

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INTRODUCTION: Reported incidence of blood transfusion following primary and revision total knee arthroplasty (pTKA, rTKA) has decreased considerably compared to historical rates. However, it is not known if further adoption of techniques to limit transfusions has resulted in further reduction on a large scale. The purpose of this study was to assess recent trends in blood transfusions and contemporary risk factors for transfusions using a large, national database.

METHODS: The American College of Surgeons National Surgical Quality Improvement Program was queried to identify patients undergoing pTKA and rTKA between 2011 to 2019. pTKA for fracture, infection, tumor, and bilateral procedures were excluded. Only aseptic rTKA were included. Annual incidence of transfusions and proportion of patients with optimized preoperative hematocrit (HCT) (defined as $\geq 33\%$) were assessed. Risk factors for transfusion were evaluated with 2018 and 2019 data using multivariate analyses.

RESULTS: 382,976 pTKA and 22,262 rTKA were included. Transfusion following pTKA decreased from 17.6% in 2011 to 0.7% in 2019 and from 19.4% in 2011 to 2.6% in 2019 for rTKA ($p < 0.0001$). Patients with optimized HCT increased for pTKA (96.9% in 2011 vs. 98.3% in 2019, $p < 0.0001$) and rTKA (95.3% in 2016 vs 97.3% in 2019, $p < 0.0001$). Decreased HCT was most strongly associated with transfusions, with each three-point change corresponding to odds ratio of 7.21 and 19.8 for pTKA and rTKA, respectively. Increased age, female sex, history of bleeding disorders or preoperative transfusion, ASA score ≥ 3 , HCT $< 33\%$, non-spinal anesthesia, and longer operative times were also associated with increased odds for transfusion.

CONCLUSION: Incidence of blood transfusion has continued to decrease following pTKA and rTKA. Despite care improvements, transfusions still occur in certain high-risk patients. While transfusion in pTKA may have reached the lower asymptote, further reduction in rTKA may be possible through further improvements in preoperative optimization and surgical technique.

Poster 35

Impact of Increased Age on Cementless Total Knee Arthroplasty Outcomes and Survivorship

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INTRODUCTION: Early cementless total knee arthroplasty systems were heavily scrutinized for component loosening secondary to micromotion of the joint. The development of improved cementless knee systems over the last several years has resulted in a gain in popularity in cementless implants. However, there remains a concern over component loosening hypothetically in the elderly due to poor bone quality. The purpose of our study is to elucidate cementless total knee arthroplasty outcomes and to stratify outcomes based on age.

METHODS: A retrospective review was completed on 217 consecutive cementless total knee arthroplasties conducted by a single fellowship-trained surgeon at an urban, academic hospital center. Patient demographics, medical history, component details, intraoperative details were collected. Patients were analyzed as a single cohort and then stratified into two groups, age ≥ 75 and age < 75 , for further comparison. Outcomes followed include surgical site infection (SSI), prosthetic joint infection (PJI), deep venous thrombosis (DVT), pulmonary embolism (PE), component loosening, periprosthetic fracture, extensor failure, and revision.

RESULTS: There was an average of 4.8 years of follow-up prior to retrospective review. Complication incidences were: 0.5% SSI and PJI, 1.4% DVT with subsequent PE, 1.4% periprosthetic tibial fracture, 0.5% extensor failure, 2.8% loosening, and 3.2% all-cause revision. Stratification resulted in 170 patients < 75 years old and 41 patients ≥ 75 years old. There were no significant differences in revision rate, loosening, or periprosthetic fracture when comparing these patient groups ($p > 0.05$).

CONCLUSION: Cementless total knee arthroplasty systems showed survivorship and rates of complication comparable to their cemented total knee counterparts. Age greater than 75 did not contribute to an increased risk of arthroplasty failure. Follow-up study with the same patient cohort will help provide further survivorship data in future investigations.

Poster 36

Etiology of Thigh Pain after Total Knee Arthroplasty

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BACKGROUND: Thigh pain is relatively common after TKA and the literature attributes this to compression of the thigh muscles by the tourniquet used during TKA surgery. Cessation of tourniquet use has not led to a decrease in thigh pain after TKA and may be due to strain of the quadriceps muscle or insertion of the intramedullary rod.

RESEARCH QUESTION/HYPOTHESIS: Is thigh pain after TKA caused by a strain of the quadriceps muscle, rather than neuromuscular compression by the tourniquet or the intramedullary rod. Additionally, it is hypothesized that the strain of the quadriceps muscle is related to hyper flexion of the knee during TKA surgery and is therefore more common in patients with knee stiffness prior to TKA surgery.

METHODS: Our prospective, randomized controlled trial enrolled 100 subjects undergoing primary knee arthroplasty. Patients were randomized into one of four groups: [1] Tourniquet used with intramedullary rod (n = 30), [2] No tourniquet with intramedullary rod (n = 30), [3] Tourniquet used without intramedullary rod (n = 20), and [4] No tourniquet without intramedullary rod (n = 20). 60 patients received an MRI on POD #1. Data collected preoperatively and at POD#1, 6 weeks, and 3 months included knee pain and function (KOOS), knee range of motion, knee or thigh pain using the NPRS, thigh circumference, and presence of thigh ecchymosis and tenderness.

RESULTS: Mid-study data review on 41 subjects showed that there were no significant differences in subject characteristics such as age, sex, BMI, or knee range of motion prior to surgery between study groups (all $p > .05$). 67% of patients in the tourniquet groups reported thigh pain on POD#1 (67%), while 51% of intramedullary rod patients and 33% of patients in the no tourniquet without intramedullary rod group reported thigh pain, however, this difference was not significant ($p = .255$). Range of motion measures were not different between groups with an average extension of $9.1 \pm 4.7^\circ$ and flexion of $98.1 \pm 16.5^\circ$ ($p = .982$ and $p = .767$ respectfully).

CONCLUSIONS: The etiology of thigh pain is elusive after TKA as the use of a tourniquet or intramedullary rod did not significantly impact pain or range of motion measures when compared to patients in the no tourniquet and no intramedullary rod group. Further research is needed to determine why approximately 40% of patients report significant pain and ecchymosis after TKA.

Poster 37

When Do We Indicate TKA? Five-Year Trends and Patient-Determinants of Baseline Pain and Function

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BACKGROUND: Baseline patient-reported outcome measures (PROMs) may influence improvement extent following total knee arthroplasty (TKA). Shift towards more patient-centered, improvement-based, and value-driven healthcare prompted some insurance providers to include them in the reimbursement valuation. Emphasis on baseline PROMs requires an improved characterization of their temporal and demographic variability. We aimed to understand (1) baseline PROMs trends over five-years stratified by patient determinants; (2) patient-factors associated with poor preoperative pain and function (25th percentile); and (3) potential inter-surgeon variability in PROM thresholds for surgical candidates.

METHODS: A cohort of 9,195 primary TKAs was prospectively enrolled in a tertiary healthcare data collection system (January 2016-December 2020). Demographics, comorbidities, surgeon details, and baseline PROMs were collected pre-TKA. Outcomes included in KOOS-pain, and KOOS-PS (i.e., function) quarterly trends over the five-year interval, stratified by sex and race in addition to the baseline KOOS-pain/PS values of the five-year cohort regardless of temporal trends. Trends and multivariable regression analyses assessed temporal variation and associations with patient factors.

RESULTS: Overall, the mean KOOS-pain and KOOS-PS were 40.0 (± 16.4) and 47.3 (± 16.8). Baseline KOOS-pain exhibited consistent means across quartiles ($p = 0.112$). Baseline KOOS-PS demonstrated progressively improving function over time (2016-Q1: mean = 47.1; 2020-Q4: mean = 49.6; $p < 0.001$). Such improvement was appreciable in males ($p = 0.003$), females ($p = 0.01$), and White patients ($p < 0.001$) but not Black patients ($p = 0.63$). There was significant inter-surgeon preoperative variation in mean KOOS-pain (range: 34.7-46.4; $p < 0.001$) and-PS (range: 47.6-57.7; $p < 0.001$). Higher odds (OR) of poor baseline KOOS-pain and-PS were detected among females (OR:1.59; 95% confidence interval (CI) [1.42- 1.77]; $p < 0.001$ and OR:1.48; 95% CI: [1.31-1.66]; $p < 0.001$), Black patients (OR:1.86; 95% CI [1.63-2.12]; $p < 0.001$ and OR: 1.48, 95% CI [1.29-1.7]; $p < 0.001$), current smokers (OR: 1.54, 95% CI [1.28-1.85]; $p < 0.001$ and OR: 1.35, 95% CI [1.11- 1.65]; $p = 0.002$), and Medicare/Medicaid insurance recipients (OR: 1.28; 95% CI [1.12-1.45]; $p < 0.001$ and OR: 1.29, 95% CI [1.13-1.47]; $p < 0.001$), respectively.

CONCLUSION: In our institution, patients are receiving TKA at lower preoperative functional impairment compared to five years ago. Such trend was not evident among Black patients who have been at consistently relatively low function. Patient-determinants and surgeon practice may influence pain/functional impairment levels prompting surgery. Providers and policymakers should account for the evolution of baseline PROMs and ensure equitable access.

Poster 38

How Does Alignment Affect Outcomes of Meniscal Repair

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BACKGROUND: The primary function of the meniscus is to facilitate transmission of forces across the tibiofemoral joint. The coronal plane alignment of the lower limb alters the amount of load transferred through each tibiofemoral compartment. Differences in tibiofemoral contact pressures resulting from varus or valgus alignment of the lower limb may influence outcomes following meniscal repair.

PURPOSE: The purpose of this study is to compare the outcomes following meniscal repair among patients with varus, valgus, or neutral knee alignment.

HYPOTHESIS: Preoperative limb alignment will influence clinical outcomes following meniscal repair.

METHODS: Patient demographic and surgical data were retrieved from chart review of all meniscus repairs performed at an academic center between 2006 and 2018. Imaging from preoperative bone length studies were used to measure limb alignment. Patients were contacted and results assessed through identification of any additional surgery on the index meniscus (repair failure) and patient-reported outcome scores (Knee injury and Osteoarthritis Outcome Score [KOOS], Marx activity score, and International Knee Documentation Committee [IKDC] score. Repair failure risk and patient-reported outcomes were compared between patients in who a repair was performed in an "at risk" knee (lateral meniscus repair in a valgus knee or medial meniscus repair in a varus knee) and the remaining patients.

RESULTS: Of the 669 meniscus repairs performed during the study period, 50 had preoperative bone length studies and completed patient-reported outcome scores at a mean of 1.56 years postoperative. Among these patients, 19 were identified as being "at risk" based on alignment. Repeat surgery on the index meniscus (repair failure) was performed in 3 of the 19 patients (16%) in the "at risk" group and in 5 (16%) of the remaining 31 patients (16%) ($p = 1.00$). There were no significant difference KOOS pain (88.4 vs. 82.5, $p = 0.17$), symptoms (79.7 vs. 79.1, $p = 0.91$), ADLs (94.8 vs. 89.2, $p = 0.14$), Sport/Rec Function (71.3 vs. 63.9, $p = 0.42$), or QOL subscales (67.5 vs. 55.7, $p = 0.12$), IKDC score (75.8 vs. 65.6, $p = 0.10$), or Marx score (6.1 vs. 4.0, $p = 0.18$) between the two groups.

CONCLUSION: Preoperative limb alignment does not appear to influence clinical outcomes following meniscal repair. Further study with larger numbers is required to confirm these findings.

Poster 39

Combined Preoperative PROMs Phenotypes (Pain, Function, and Mental Health) Predict Outcome Post-TKA

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INTRODUCTION: Value-driven healthcare has prioritized Patient-reported outcome measures (PROMs). Often analyzed separately as metrics of pain, function, activity, and mental health, from patient perspective these factors are interconnected; interpreting together integral to patient status. The objective of this study was identifying preoperative PROM phenotypes associated with negative response to patient acceptable symptom state (PASS) one year following total knee arthroplasty (TKA).

METHODS: A prospective cohort of 5,437 patients who underwent primary unilateral TKA for osteoarthritis (January 2016 - December 2019) were included with 97.5% baseline data collection. Preoperative PROM scores of Knee Disability and Osteoarthritis Outcome Score (KOOS) pain, KOOS physical short form (PS) and Veteran's Rand-12 (VR-12) mental component summary (MCS) were used to develop 8 patient phenotypes by below (-) or above (+) median of the cohort. Phenotypes were denoted as: 1) Pain-PS-MCS-, 2) Pain-PS-MCS+, 3) Pain-PS+MCS+, 4) Pain-PS+MCS-, 5) Pain+PS-MCS-, 6) Pain+PS-MCS+, 7) Pain+PS-MCS-, 8) Pain+PS+MCS+. PROMs were on a scale 0-100 with 0 being worse, thus (-) denoting poorer scores. The primary outcome of the study was PASS (assessment of satisfaction) at one year. Multivariate regression assessed association between preoperative phenotype and negative PASS while adjusting for patient demographic and comorbidities.

RESULTS: 16.4% (n = 892) of the cohort reported their state 'not acceptable' (i.e. PASS) at one year. Race (Black, odds ratio [OR]: 1.45, 95% confidence interval [CI]: 1.18-1.78 and phenotype were significantly associated with negative PASS. Using Pain+PS +MCS+ as reference group, Pain-PS-MCS- was associated with the highest odds of negative PASS among the phenotypes (OR: 2.11, 95% CI: 1.69 - 2.64). Pain-PS+MCS- had the second highest odds of negative PASS (OR: 1.96, 95% CI: 1.3 - 2.96), followed by Pain+PS-MCS- (OR: 1.92, 95% CI: 1.3 - 2.96), Pain-PS-MCS+ (OR: 1.56, 95% CI: 1.21 - 2.01) and Pain+PS+MCS- (OR: 1.43, 95% CI: 1.09 - 1.88).

CONCLUSION: Patients with lower preoperative scores across multiple PROMs have increased odds of dissatisfaction after TKA. When counseling patients for TKA, measuring pain, function, and MCS concurrently as phenotypes to identify patients at risk for not achieving a satisfactory outcome.

Poster 40

Influence of Patellofemoral Anatomy on Patient-Reported Outcomes of Isolated Medial Patellofemoral Ligament Reconstruction

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INTRODUCTION: Patellar height and tibial tubercle-trochlear groove (TT-TG) distance are known to predispose patients to lateral patellar dislocations and recurrent instability. The purpose of this study was to evaluate the influence of preoperative radiographic measurements on patient-reported outcomes following isolated medial patellofemoral ligament (MPFL) reconstruction.

METHODS: A search of billing records and chart review identified patients who underwent isolated MPFL reconstruction at a single institution between 2008 and 2016. Performance of an isolated MPFL reconstruction was at the discretion of the operating surgeon with the primary indication for tubercle osteotomy being a large j-sign. Patient demographics and surgical details were collected via chart review, and patients were contacted to collect patient-reported outcomes including the Norwich Patellar instability Score (NPI), the Knee injury and Osteoarthritis Outcome Score (KOOS), and Marx Activity Score. Preoperative imaging was reviewed, and patellar height (Caton-Deschamps index [CDI]) and TT-TG distance were measured. Patients were grouped based on CDI > 1.20 vs. CDI < 1.20 and TT-TG > 20 mm vs. TT-TG < 20 mm, and outcomes were compared using independent samples t-test with Bonferroni correction.

RESULTS: During the study period, 165 patients underwent isolated MPFL reconstruction. 125 patients (76%) with minimum one-year follow-up were contacted at a mean of 5.2 years following surgery. Recurrent dislocation occurred in 5 patients (4%). Preoperative radiographs were available in 111 patients (89%), and preoperative MRI was available in 89 patients (71%). Mean CDI was 1.13, and 35% had a CDI > 1.20. Mean TT-TG distance was 17.5 mm, and 26% had a TT-TG distance greater than 20 mm. No significant differences in patient-reported outcomes were noted based on patella alta or elevated TT-TG distance.

CONCLUSION: In patients without a large j-sign, neither moderately elevated TT-TG distance nor patellar alta are associated with poorer patient-reported outcomes following MPFL reconstruction.

Poster 41

Pre-Operative Opioid Consumption Affects Patient Satisfaction Following Total Knee Arthroplasty

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INTRODUCTION: A history of chronic opioid consumption within three months prior to total knee arthroplasty (TKA) surgery date has been implicated in adverse outcomes following primary TKA. The objective of this study was to determine clinical outcome measures and satisfaction in patients with a history of preoperative chronic opioid use undergoing primary TKA.

METHODS: This is a retrospective cohort study of 296 consecutive patients undergoing primary TKA. 74 patients (25%) had chronic preoperative opioid use. A 3:1 matched cohort ratio of control (non-opioid) patients to study group (chronic opioid) patients was utilized with 74 patients (22 male, 52 female) in the study group with an average age of 65 years, BMI of 32.6, and follow-up of 24 months. The control group consisted of 222 patients (97 male, 125 female) with an average age of 66 years, BMI of 31.3, and follow-up of 24 months. There was no statistically significant difference in age, BMI, or follow-up between cohorts; there was a difference in gender ($p = 0.033$). Outcome measures evaluated included patient satisfaction (Likert 1-5), pre/postop Knee Society (KS) Knee scores, pre/postop KS Function scores, WOMAC, KOOS Jr., and complications.

RESULTS: The incidence of patients being either satisfied or very satisfied was 206/222 (92.8%) in the control group, compared to 62/74 (83.8%) in the study group ($p = 0.022$). The overall satisfaction of the control group on a scale of 1-5 was 4.63 (range 1-5) vs. 4.30 (range 2-5) in the study group ($p = 0.0016$). Statistically significant differences in PROM's comparing the control group to the opioid cohort included: WOMAC of 85.7 vs. 77.7 ($p = 0.00087$), KOOS Jr. of 84.6 vs. 76.1 ($p = 0.0004$), postop KS Function Score of 83.2 vs. 75.3 ($P = 0.0034$), respectively. The postop KS Knee Scores were 89.5 vs. 88.1 ($p = 0.4075$). Opioid usage at 4-8 weeks postoperatively was 62/222 (27.9%) and 56/74 (75.7%) in the control and study groups, respectively ($p < 0.00001$). Incidence of opioid use at 1 year postop was 4/222 (1.8%) and 27/74 (36.5%) in the control and opioid groups, respectively ($p < 0.00001$). There was not statistically significant difference in revision surgery or overall complications between groups.

CONCLUSION: Patients with chronic preoperative opioid use are more likely to have lower satisfaction with their knee replacement, higher rates of chronic opioid use, and worse outcomes including lower WOMAC, KOOS Jr., and KS Function scores compared to patients without a history of opioid use prior to TKA.

Poster 42

Outcomes After Arthroscopic Posterior Capsular Release for Persistent Extension Deficit of the Knee

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PURPOSE: Posterior capsular contracture of the knee can manifest secondary to surgical insult or trauma, resulting in functional deficit and poor patient outcomes. The purpose of our study was to evaluate the clinical efficacy of arthroscopic posterior capsular release for improving knee extension and to determine subjective patient outcomes postoperatively.

STUDY DESIGN: Case series level IV

METHODS: Retrospective chart review was performed to identify patients who underwent arthroscopic posterior capsular release due to persistent extension deficit of the knee between 2008 and 2021. Patient characteristics, surgical and nonoperative interventions, knee ROM, and patient-reported outcomes (IKDC, Tegner, and VAS) were collected at final follow-up. Pre- and postoperative VAS and knee range of motion were compared using Wilcoxon signed rank tests.

RESULTS: Overall, 22 patients were included with a median age of 37 years (interquartile range (IQR) 20.5-44.3). Of these, 8 (36%) were male and 14 (64%) were female, and average follow-up was 3.7 years (range 0.3-12.3). Manipulation under anesthesia was previously performed in 9 patients (41%) and arthroscopic debridement in 11 patients (50%). The most common operation preceding the development of extension deficit was anterior cruciate ligament (ACL) reconstruction (59%). Median preoperative extension was 15° (IQR 10-25) compared to 2° (IQR 0-5) immediately postoperatively ($P < .001$). At final follow-up, median extension was 0° (IQR 0-3.5). Patients who experienced ACL related extension deficit were more likely to report better IKDC (81 vs. 51.3, $p = .008$), Tegner (5.8 vs. 3.6, $p = .007$), and VAS pain scores (rest: 0.2 vs. 1.8, $p = .008$; use: 1.3 vs. 5, $p = .004$).

CONCLUSION: Arthroscopic posterior capsular release provides an effective means for reducing pain and restoring terminal extension in patients with recalcitrant extension deficit due to capsular contracture. The improvement in extension postoperatively was maintained for most (94%) patients at final follow-up.

Poster 43

Single-Sport Athletes Not Experiencing Increase in Secondary Tear Incidence Despite Earlier Clearance

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BACKGROUND: In response to increased pressure for athletes to pursue sports-specialization at earlier ages, multi-sport participation has been encouraged for protection from over-use injury and diversified athletic development. It is unclear whether participation in multiple sports protects against re-injury.

OBJECTIVES: To compare functional recovery, psychological recovery, and secondary injury between single and multi-sport pediatric athletes after primary ACL reconstruction (ACLR).

METHODS: Following IRB approval, prospectively collected data on consecutive patients treated for ACL injury (1/2015-2/2018) in a pediatric sports medicine clinic was reviewed. Patients indicated sports participation on a standardized electronic survey, which allowed for categorization as single- or multi-sport athletes. Patients lacking two-year follow-up were contacted via phone and questioned on sports participation, return to primary sport, and any secondary injury. Inclusion required primary ACLR within the study window, participation in sport(s) at the time of injury, age ≤ 19 , a complete Y-balance test 6-9 months after surgery, and a at least 2 years post-surgery follow-up. Demographic information, injury characteristics, surgical data, functional clearance data (Y-balance testing), functional and psychological patient reported outcome measures (PROM), return-to-play clearance, and reinjury were reviewed. Categorical variables were compared with a Chi-Square or Fisher's exact test. Continuous variables were compared with a Mann-Whitney test.

RESULTS: 145 patients met inclusion criteria [age: 14.23 ± 2.09 , range: 7-18, 49.66% female]. Single-sport athletes comprised 53.79% of the cohort ($n = 78$). Females accounted for 57.69% of single-sport athletes, while males accounted for 58.21% of multi-sport athletes ($n = 45$, $n = 39$, $p = .0562$). The largest portion (37.18%) of single-sport athletes listed soccer as primary sport, while the largest portion (38.81%) of multi-sport athletes listed football as primary sport ($n = 29$, $n = 26$, $p = .0006$).

Single-sport athletes showed higher scores on Pedi-IKDC prior to surgery (51.62 ± 19.20 vs. 43.73 ± 21.77 , $p = .04$). Single-sport athletes were also cleared fewer days after surgery than multi-sport athletes (271.09 ± 100.08 vs. 313 ± 109.66 , $p = .02$). Despite single-sport athletes obtaining clearance earlier than multi-sport athletes, there was no difference in incidence of secondary ACL injury within 2 years of surgery ($p = .84$).

CONCLUSION: Although single-sport athletes attained clearance in a shorter time than multi-sport athletes, no difference was found in rate of secondary ACL injury within two-years of follow-up.

Poster 44

Shifting Trends in Arthroplasty Patient Characteristics Following the COVID-19 Shutdown

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BACKGROUND: In response to COVID-19, hospitals across the U.S. abruptly postponed elective hip (THA) and knee (TKA) arthroplasty temporarily. This study compared patient demographics, baseline health characteristics, rates of inpatient and outpatient procedures, complication rates, and patient-reported outcome measures (PROMS) before and after the COVID-19 elective arthroplasty shutdown.

METHODS: 786 patients undergoing THA or TKA for osteoarthritis at a suburban academic center were retrospectively reviewed. After exclusions for confounders, 379 THA/TKA patients between May 1 and December 31, 2019, (pre-COVID-19) were retrospectively compared to 407 THA/TKA patients during the same time period one-year later (post-COVID-19). Medical data including the Outpatient Arthroplasty Risk Assessment (OARA) score, a validated medical risk stratification algorithm, were obtained via chart review and outcome measures were extracted from our prospectively collected database.

RESULTS: Post-COVID-19 patients were younger (median of 65 vs. 67 years, $p = 0.004$), had better ASA physical status scores of 1 or 2 (52% vs. 44%, $p = 0.032$), and lower OARA scores (median of 15 vs. 30, $p = 0.043$). Prior to the pandemic, 56% and 44% of cases were Medicare/Medicaid and privately insured/self-pay, respectively. Post pandemic, these proportions were reversed (46% vs. 54%, respectively, $p = 0.023$). More surgeries were performed as outpatient procedures post-COVID-19 (55% vs. 28%, $p < 0.001$) with a concomitant increase in successful same day discharge following the pandemic (56% vs. 28%, $p < 0.001$). There were no differences in 90-day postoperative complication rates ($p \geq 0.084$) or HOOS Jr., KOOS Jr., or UCLA activity level outcomes ($p \geq 0.121$).

CONCLUSION: Study findings indicate that younger, healthier patients qualifying for safe outpatient surgery were more likely to proceed with THA/TKA immediately following the COVID-19 shutdown. Conversely, older and sicker patients may have delayed surgical treatment for hip and knee arthritis, presumably due to apprehension or other factors related to the COVID-19 pandemic.

Poster 45

Failure to Launch: Risk Factors and Prevention in Same-Day Discharge Following TJA

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BACKGROUND: Rapid recovery protocols have enabled the transition of total joint arthroplasty (TJA) from the inpatient to outpatient setting. However, reasons for same-day discharge (SDD) failure have not been comprehensively identified. This study explored barriers to successful SDD following primary TJA.

METHODS: A retrospective review of 398 consecutive primary unilateral TJAs performed by a single surgeon at an academic center between 2017 and 2020 with planned SDD was performed. Failure of SDD was defined as lack of discharge before midnight on the day of the procedure. Failure to achieve SDD was examined in relationship to 35 demographic, medical, social, and psychological characteristics of patients; intraoperative factors; and postoperative complications.

RESULTS: Fifty-seven percent of the sample was female, with average age and BMI of 58 (19 to 83) years and 31 (18 to 54) kg/m². A binary logistic regression model retaining age, the Outpatient Arthroplasty Risk Assessment (OARA) score, morphine milligram equivalents (MMEs) consumed per hour, and postoperative urinary retention ($p \leq 0.003$) explained 74% of the variance in failed SDD. Every five-year increase in age, 20 point increase in OARA score, and increase of 0.5 MMEs consumed per hour increased the likelihood of failure by 1.9 (95% CI 1.2, 2.9), 2.4 (95% CI 1.5, 3.8), and 4.0 (95% CI 2.4, 6.6) times, respectively. On average, patients who failed SDD (18 ± 19) traveled fewer miles for surgery than those who achieved SDD (27 ± 30 , $p > 0.05$).

CONCLUSION: Increasing age and comorbidities as reflected in OARA scores are predictive risk factors for failure to launch, highlighting the importance of patient selection when planning SDD. Urinary retention is a key complication that can prevent SDD. Successful outpatient TJA relies on the adoption of modern perioperative protocols, appropriate patient selection, and the ability to predict and prevent the common postoperative problems that routinely result in failure to launch.

Poster 46

Effect of Primary Language on Access to Orthopedic Clinics in South Florida

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INTRODUCTION: Language barriers present a significant challenge in providing high quality health care; impeding the informed consent process, understanding of postoperative instructions and rehabilitation after orthopedic surgery. This is especially pressing in America with our growing immigrant population, with 30% of Florida speaking non-English languages. Access to multilingual healthcare providers or interpreters can be a barrier in an orthopedic office resulting in delayed appointment times, delayed treatment, and subsequently impact outcomes. The purpose of this study was to determine the effect of language spoken on a patient's ability to access orthopedic care in urgent situations of acute increased pain.

METHODS: Forty-six orthopedic centers were identified in Broward, Palm Beach County (PBC), and Miami-Dade County (MDC) by Google search and selected via random number generator. Each facility was called with a script of a simulated Orthopedic patient case to request an appointment for evaluation of knee pain for a relative who spoke exclusively English or Spanish. The ability and time to schedule an appointment and interpretation type were recorded. Calls were repeated with a waiting period of at least five days and from different phone numbers to prevent recognition.

RESULTS: The average time to appointment overall was 6.4 business days. Overall, there was no increased time to appointment for a Spanish-speaking patient (4.8 days) compared to English (7.8; $p=0.16$). There was a significant difference in average time between counties (3.4 days for PBC, 8.8 for Broward, and 8.2 for MDC); PBC had a shorter appointment time compared to MDC ($p=0.008$) and BC($p=0.03$). PBC had a similar Spanish-speaking wait time to MDC(3.25 vs. 6.5; $p=0.25$). About 80% of clinics had Spanish interpretation, 43% in the form of a multilingual provider, and the rest in the form of staff members. Three-quarters of clinics in PBC provided interpretation vs. 100% in MDC ($p=0.17$) and 50% in Broward ($p=0.48$).

DISCUSSION: Our results demonstrated that even though orthopedic surgery may struggle to increase diversity in its membership, access for diverse ethnic and multilingual patients is not an issue. Orthopedic offices in the South Florida area provided similar access to care for Spanish-speaking patients, however, the average wait time between counties differed significantly. While most clinics had Spanish interpretation, type of interpretation differed. Further studies are warranted to evaluate quality of care provided with different types of interpretation as well as other potential barriers to access care, such as socioeconomic status and location of clinics by zip code.

Poster 47

Influence of Dual Eligibility Status on 90-Day Outcomes Following Primary Total Hip Arthroplasty

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INTRODUCTION: Dual eligibility status (qualifying for both Medicare and a Medicaid supplement) has recently been proposed by Centers for Medicare and Medicaid Services as a socioeconomic qualifier to risk-adjust for patients undergoing primary total joint arthroplasty (TJA). The validity of dual eligibility status (DES) as a marker of socioeconomic status has not previously been studied in TJA. This study's purpose was to compare the 90-day outcomes, including complications and costs, between primary total hip arthroplasty (THA) patients who meet DES and a non-Medicare, non-Medicaid cohort.

METHODS: A retrospective case-control study of the mariner database within the PearlDiver server between 2010 and 2019 was performed. Payer status was identified, and patients were propensity score matched to non-Medicare, non-Medicaid controls based on age and gender distribution, Charlson comorbidity score, and nine different medical comorbidities with nearest neighbor pairing at a 1:1 ratio. 90-day medical and surgical outcomes and reimbursements were compared between the DES cohort and the non-Medicare, non-Medicaid cohort using Chi-Square analysis.

RESULTS: 4,750 DES patients were successfully matched and evaluated. The DES cohort had significantly greater transfusion rates (6.8% vs. 3.9%, $p < 0.001$), longer average LOS (4.8 vs. 4.2 days, $p = 0.02$) and increased average 90-day reimbursements (\$25,829 vs. \$18,983, $p = 0.005$). There were no differences between the groups in other complications.

CONCLUSION: Dual eligibility status patients experience a longer length of stay, greater transfusion rate, and increased cost per episode of care when compared to a propensity matched control group following primary THA. This study justifies socioeconomic risk stratification to adjust TJA reimbursement models. Without risk adjustment, providers and hospitals may be hesitant to take on the added financial risk of DES patients, which will limit access to an already marginalized patient population.

Poster 48

Risk of Recall Among Orthopedic 510(k) Medical Devices

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BACKGROUND: Over 90% of orthopedic devices reach market without supporting clinical evidence via the FDA's 510(k) pathway. Studies indicate orthopedic devices represent between 20-41% of all recalls raising safety concerns. However, limitations in study design hamper applicability of these results. The goal of the present study is to examine the risk of recall for orthopedic 510(k) devices. We hypothesized spine devices were more likely to undergo recall than arthroplasty devices. Secondary outcomes include analyzing risk of multiple recalls and reason for recall.

METHODS: The FDA 510(k) database was queried setting dates between 01/01/2008 to 12/31/2017 and filtering "Advisory Committee" to orthopedics. Recall information including date, class, and reason were recorded in January 2020 providing minimum of 2-year follow-up for recall. Devices were then codified using FDA product codes into "Spine", "Large Joint Arthroplasty (LJ)", "Medium/Small Joint Arthroplasty" (MSJ), and "Other". Descriptive data and statistical analyses were performed using Excel and SPSS. Chi-square tests and two proportions test were conducted. Alpha level is set at 0.05.

RESULTS: Of the 5,376 devices included, 579 (10.8%) were recalled with 7 (1.2%) being high-risk recalls. Spine contributed the most devices with 2,190 (40.7%), but presented lower risk of recall than LJ (1,027 devices [19.1%]) and MSJ (63 devices [1.2%]), with 7.2%, 18.5%, and 20.6% of devices recalled, respectively ($p < 0.001$). Of the 579 recalled devices, 130 (22.5%) were recalled again causing 788 total recalls. This was significantly greater ($p < 0.001$) than the baseline risk of recall of 10.8%. Lastly, packaging/processing accounted for 205 (26%) of recalls, followed by device design (157 [19.9%]) and labeling errors (140 [17.8%]) with no differences between groups.

CONCLUSION: The study presents the first estimation of risk of orthopedic 510(k) device recall. Arthroplasty devices pose increased risk of recall as do devices previously recalled. No differences regarding reason for recall were found, but inconsistencies within the recall database complicate clinical interpretation. We recommend improved data collection and further investigation into device recall to improve safety.

Poster 49

Dual Eligibility THA Patients Have Higher Comorbidity Burdens Compared to Privately Insured Patients

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INTRODUCTION: Dual eligibility status (qualifying for both Medicare and a Medicaid supplement) has recently been proposed by the Centers for Medicare and Medicaid Services as a socioeconomic qualifier to risk-adjust for patients undergoing primary total joint arthroplasty (TJA). However, no study has determined whether there is a difference in comorbidity rates between patients who meet dual eligibility status (DES) and patients who are privately insured.

METHODS: A retrospective case-control study of the Mariner database within the PearlDiver server between 2010 and 2017 was performed. Patients aged 60-80 were included and stratified based on payer type: DES vs. private payer. For this study, patients who underwent primary THA were included and the comorbidity burden of the 36 most common comorbidities was compared. Chi-square testing was used to compare the prevalence of comorbidities with a p-value less than 0.01 deemed statistically significant.

RESULTS: The private payer group included 315,664 patients and the DES cohort included 3,107 patients. The DES patients were overall older and had a greater prevalence of the majority of the comorbidities studied (31 out of 36, $p < 0.001$) including: coronary artery disease, hypertension, cerebrovascular disease, obesity, rheumatoid arthritis, asthma, chronic obstructive pulmonary disease, chronic kidney disease, coagulopathy, dementia, tobacco use, drug and alcohol abuse, and HIV.

CONCLUSION: Dual eligibility status patients have meaningfully different comorbidity profiles when compared to privately insured patients. The higher comorbidity burden in DES patients includes many comorbidities that have been previously associated with a greater risk of perioperative complications following primary TJA. Risk adjustment should account for these differences in the setting of an alternative payment model. Without appropriate risk adjustment, providers and hospitals may be hesitant to take on the added financial risk of these more complex DES patients, which could limit access to an already marginalized group of patients.

Poster 50

Effect of Wound Irrigation Solutions on Uninfected Host Tissue - A Skin Punch Murine Model

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INTRODUCTION: Many irrigation solutions are commercially used by orthopedic surgeons to reduce bacterial contamination and prevent or treat infection. However, the effects of these solutions on healing capacity of skin and subcutaneous tissue has not been well established. The purpose of this study was to investigate the effects of five commonly used irrigants on tissue inflammatory response using a murine model.

METHODS: Bilateral full thickness wounds were created on the backs of 40 BALB mice with a biopsy puncher, then splinted and sutured. There were five groups based on the treatment solution: Bacitracin, Clorpectin 0.2%, Irrisept (Chlorhexidine Gluconate 0.05%), Prontosan, and Bactisure. Each mouse served as its own control. Solution was applied to one side and the opposite side washed with 9% normal saline, followed by application of occlusive dressing. Mice were sacrificed at three days and the wounds excised for histologic analysis. Wound response was graded on a scale from mild to severe. Inflammation was evaluated by the degree of serocellular crusting, epidermal hyperplasia with intracellular edema (spongiosis), fibroplasia, ulceration, hemorrhage, and necrosis.

RESULTS: All irrigants negatively affected host tissue in varying degrees. All irrigants produced moderate to severe serocellular crusting with or without presence of degenerative neutrophils. All irrigants produced mild to moderate epidermal hyperplasia. Reactive fibroblasts and fibroplasia were less common findings for all irrigants. All irrigants except Bactisure induced ulceration. Three irrigants-Irrisept, Bactisure, and Prontosan-caused occasional hemorrhage in the dermis.

CONCLUSION: In the absence of contaminated wounds, these results suggest that in the acute phase, living tissue can be damaged by various irrigation solutions. This evidence provides a better understanding of the recovery potential of skin wounds when subjected to these potent anti-infective agents and encourages further investigation into their effects on later phases of healing in both healthy and infected tissue.

Poster 51

Reported Versus True Incidence of Surgical Sharps Exposures in an Urban, Academic Hospital Center

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INTRODUCTION: While there has been organizational pressure to implement preventative safety nets and protocols, sharps exposures continue to incur avoidable costs. The purpose of this study is to elucidate the frequency of unreported sharps incidents and reasons behind noncompliance.

METHODS: An anonymous survey was sent to all surgical personnel (199 surgeons, 441 other staff) in an urban, academic health center, including attending and resident physicians, surgical technicians, and first assists. Survey results were compared to actual sharps incidence reports from the hospital quality and safety department from January 2020 to February 2021.

RESULTS: 34.6% of the 156 respondents reported a sharps exposure in the last year, with the primary causes being suture needle (69.0%), hypodermic needle (12.1%), and scalpel (10.3%), or wire/pin (4.3%). Actual hospital reports endorse only 65 official sharps reports in the last year. Only 41.5% endorsed they completed hospital reporting protocol, including use of a hotline and bloodwork. For those who did not report exposures, 32% stated it was due to inconvenience, 28% due to benign patient history, 25% due to unclear extent of exposure, 5% due to not knowing protocol, and 4% due to possible peer-to-peer criticism. Both actual reported and surveyed exposures showed orthopedics and general surgery had the highest absolute and relative incidences, with a predilection in those less than 50 years of age. Awareness of hospital protocols increased by age group, with 78% awareness in those 20-30 years old and 100% awareness in those greater than 60 years old.

CONCLUSION: Hospital emphasis on sharps safety and protocols have presumably masked the actual risk of sharps exposure to healthcare workers, with many employees finding protocols inconvenient or not knowing the protocol altogether. This study emphasizes the need for further protocol streamlining, more aggressive sharps education, and the study of further protective technologies.

Poster 52

Afterhours Patient Phone Calls: A Quality Improvement Study for Patient and Resident Wellbeing

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BACKGROUND: Factors that contribute to physician and resident burnout have been analyzed across many surgical specialties and decreasing overall work burden has been associated with decreased provider burnout scores. Additionally, improving resident on-call experience has also shown to improve overall resident satisfaction and wellness ratings. To target areas of improvement in resident workload, as well as identify potential areas for enhancing patient care and education, a study was conducted to evaluate phone calls from patients taken by on-call orthopedic residents at a single institution.

METHODS: 510 patient phone calls over 82 shifts were documented by on-call orthopedic surgical residents. The length, nature, and associated attending physician of each call was recorded as well as whether the call resulted in an emergency room visit. The nature of each phone call was categorized into one of the following 12 categories: pain, loss of motor or sensory function, wound formation or incision concern, wound drainage, problems with splints, pins, or external fixation, difficulty with dressings or wound VAC, prescription or pharmacy concerns, surgery questions, scheduling conflicts, fever, peripheral nerve catheter and pump questions, and other.

RESULTS: Overall, orthopedic surgical residents take an average of 8.6 patient phone calls for an average total of 53.3 minutes per shift. Friday evenings and Saturdays had the highest call burden. The minimum and maximum total call minutes per shift was 5 and 195, respectively. The most common reasons for the phone calls were pain (40.3% of calls, 22.1 minutes per shift), prescription and pharmacy concerns (15.6% of calls, 7.07 minutes per shift), and wound formation and incision concerns (10.1% of calls, 6.71 minutes per shift). Twenty-one (4.1%) of phone calls resulted in an ED visit.

CONCLUSION: Concerns about pain, prescriptions, and wound healing were amongst the most common reasons for patient phone calls, with the first 2 accounting for over half of all calls.

DISCUSSION: Identifying common patient concerns and providing enhanced patient education prior to surgery and at discharge could improve patient care and decrease phone calls, helping to alleviate an aspect of orthopedic resident on-call work burden. Better understanding of the reasoning behind calls related to pain control and prescriptions may help guide how pain is discussed with patients, providing patients with reasonable expectations for pain control and function, and tools for better self-efficacy.

Poster 53

Eliciting Emotion and Action Increases Social Media Engagement: An Analysis of Influential Orthopaedic Surgeons

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PURPOSE: The purpose of this study is to analyze (1) the instagram practices of current orthopedic surgeons and (2) the components associated with highest reach and interactions.

METHODS: The top 25 orthopedic surgeon instagram profiles using the hashtag #ortho were ranked by the number of followers. Account information regarding followers, posts, engagement percentage, average likes, average comments, average video view, average video likes, average video comments, and estimated cost per post was recorded using social media marketing tools. An analysis of each instagram profiles' top 10 posts, based on number of likes, was conducted. A coding framework was developed to categorized posting strategies utilized.

RESULTS: Twenty-five instagram accounts and 250 instagram posts were included in the analysis. Accounts with increased engagement rating had a significantly greater number of likes and video views. When examining post characteristics that influenced the number of likes a post generated, posts that elicited negative emotions received 52.6% and 70.7% more likes than positive emotions ($p = 0.04$) and neutral emotions ($p < 0.01$), respectively. Upon assessment of posting characteristics that influenced the number of comments a post generated, promotional posts were shown to have 43.7% less comments than non-promotional posts ($p = 0.02$). When evaluating factors that influenced total number of interactions a post generated it was found that posts that asked questions generated 26.4% more interactions ($p < 0.01$) than those that do not.

CONCLUSION: The present investigation found that the most effective strategies to generate more interactions on instagram are those that elicit emotional responses and provoke viewer engagement by asking questions and directing actions. Additionally, it was found that promotional content was not well received by viewers.

CLINICAL RELEVANCE: Orthopedic surgeons have an opportunity to connect with colleagues, patients, and interested viewers through social media platforms in order to enhance their practice, disseminate educational content, and contribute to the social media presence of orthopedic surgery.

Poster 54

The Use of Telemedicine in Orthopaedic Surgery During COVID-19

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BACKGROUND: The COVID-19 pandemic has forced our healthcare system to quickly adapt to the telehealth setting. Telemedicine offers a possibility to provide high quality care with increased convenience, reduced cost, and time efficiency for patients, in addition to mitigating the spread of infection from the novel coronavirus. Recent adjustments to reimbursement policies and relaxation of HIPAA allowed for the dramatic expansion of telemedicine among various specialties. As we move forward with the use of telemedicine, it is critical we understand trends in utilization and limitations for the telemedicine technology. The purpose of this study was to evaluate telemedicine usage in orthopedics in a large regional healthcare system during the COVID-19 pandemic.

METHODS: This was a retrospective review of all telemedicine and in-person visits at a large single institution from January to December 2020. Data was collected using electronic health record platform, EPIC, and QLIK. Data regarding the number of orthopedic visits, type, location, subspecialty training of provider, and provider specifics were collected from using the QLIK database pulled from EPIC records. This data collection was compared between subspecialties including Oncology, Family Medicine, and Rheumatology and to previous year data for analyses.

RESULTS: Beginning of the 2020 year, all specialties included were not conducting virtual visits. By April 2020, Orthopedic virtual visits spiked to 33.5% as compared to Oncology at 25.5%, Rheumatology at 92.9%, and Family Medicine at 94%. From April to December 2020, orthopedic virtual visits decreased to 6.5% which was comparable to Oncology rates at 7.0%. Family medicine and rheumatology also experienced gradual declines in virtual visits through the year, however, both maintained telehealth visits at higher rates (17.4% and 26.2% respectively) in December 2020.

Orthopedic providers practicing less than 15 years, 15 to 25 years, and greater than 25 years had similar virtual visit rates (average of 39.6%, 49.2%, and 54.1% of their total patient visits).

CONCLUSIONS: As a result of the COVID-19 pandemic, changes to the provision of telemedicine led to a rapid increase in the number of virtual visits among many specialties by April 2020. However, regardless of increase in COVID lock downs, infections, hospitalizations and deaths, telehealth saw a downward trend by December 2020, particularly in procedure-based fields like orthopedics and oncology. Physicians with more years of practice and in certain subspecialties utilized telehealth at higher rates. More efforts are needed to focus on improved platforms and user efficiencies to sustain telehealth in orthopedic practices.

Poster 58

High Return to Play Rate and Reduced Career Longevity Following Surgical Management of Athletic Pubalgia in National Basketball Association Players

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PURPOSE: To assess the effects of surgical treatment of athletic pubalgia (AP) on game utilization and performance metrics in national basketball association (NBA) players.

METHODS: A retrospective review of all NBA players who underwent surgical management for AP from 1996 to 2018 was performed. A matched control group was created for comparison. The index period was defined as the entire NBA season in which surgery occurred, including the corresponding offseason. Player demographics, utilization (games played (GP), games started (GS), and minutes per game (MPG)) and performance (Player Efficiency Rating (PER)) metrics were collected for all players. Statistical analysis was performed to compare data before and after return to play.

RESULTS: Thirty-three players with a history of surgical management for AP were included in the final analysis. Following surgery for AP, NBA players were found to have a RTP rate of 90.91% (30/33). The average RTP following surgery was 4.73 ± 2.62 months. Compared to controls, athletes in the AP group played significantly fewer seasons post injury (4.17 ± 2.70 vs. 5.49 ± 3.04 seasons, respectively; $p = 0.02$). During the first year following RTP, NBA players experienced significant reductions in game utilization and performance, both when compared to the year prior and matched control ($p < 0.05$). At three-year follow-up, players continued to demonstrate significant reductions in game utilization (MPG, $p < 0.05$), but not performance.

CONCLUSION: Following surgical treatment of AP, NBA players demonstrated a high RTP rate, but shortened careers. A short-term reduction in game utilization and performance metrics were found in the first year of return to play following surgery. However, three-year follow-up performance metrics normalized when compared to healthy control.

Poster 59

Maximum Subjective Outcome Improvement is Reported by 3 Months Following Arthroscopic Partial Meniscectomy: A Meta-Analysis

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PURPOSE: To review patient-reported outcome measures (PROMs) in the literature following arthroscopic partial meniscectomy (APM) and identify when patients report maximal subjective improvement.

METHODS: A meta-analysis review of the literature from January 2004 to August 2019 was conducted using PRISMA guidelines to identify articles evaluating PROMs up to a minimum of six months after APM in patients > 18 years old. Studies were excluded if additional interventions were performed such as meniscus repairs, ligamentous reconstruction or repair, cartilaginous manipulation, or revisions. PROMs were pooled between studies at preoperative, three months, six months, one year, and two year time points. Weighted averages were used within a mixed model method in order to account for differences in sample size and variance among studies. Clinically significant improvements in PROMs at various time intervals were determined using minimal clinically important differences (MCID).

RESULTS: A total of 12 studies including 1,663 patients who underwent APM were selected for the review. The pooled cohort consisted of 1,033 (62%) males and 630 (38%) females. Clinically significant improvements were demonstrated from preoperative scores to three months postoperatively in all KOOS subcategories, Lysholm, and VAS scores while no differences were found for Tegner scores. Compared to preoperative scores, these scores remained significantly greater at all later time points; however, relative to scores at three months postoperatively, no further clinically significant improvements were reported by patients.

CONCLUSION: Patients undergoing arthroscopic partial meniscectomy report maximal medical improvement in commonly used legacy PROMs by three months, but no further clinically important improvements were noted at later time points up to two years.

Poster 60

Understanding the Epidemiology and Impact of Shoulder Injuries in Professional Baseball Position Players and Batters

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INTRODUCTION: Shoulder injuries are a relevant problem for professional baseball players. Previous literature has demonstrated a predominance of injuries in pitchers. However, there remains a lack of analysis examining shoulder injuries in professional batting athletes. Accordingly, the purpose of this study was to characterize the shoulder injuries experienced by batters, quantify the outcomes of these injuries with respect to time out of play, recurrence, and surgery rates, and identify any risk factors predictive of worse outcomes.

METHODS: Between 2011 and 2017, all Major League Baseball (MLB) and Minor League Baseball (MiLB) players who sustained shoulder injuries were identified utilizing the Major League Baseball's Health and Injury Tracking System (HITS), a prospective injury surveillance system. Injuries were included if they were sustained during baseball activity, resulted in at least one day out of play, and occurred in position players (non-pitchers). Analysis consisted of a descriptive epidemiological evaluation over a multitude of characteristics.

RESULTS: Over the study period, a total of 3,414 shoulder injuries occurred in professional batters, resulting in a total of 68,808 days missed and a mean of 22 days missed per injury. Most injuries were a result of acute trauma ($n = 2125$; 70%) with throwing as the predominant activity ($n = 1292$; 38%). Rotator cuff strain/tears was the most common diagnosis ($n = 790$; 23.1%), and superior labrum anterior posterior (SLAP) tears had the highest season-ending rate (35.3%) and need for surgical intervention (45.1%). There was a lower frequency of surgery (6.2 vs. 9.2; $P = 0.002$) and re-injury (2.03 vs. 3.62; $P = 0.007$) in the throwing shoulder. There was an increased frequency of surgery for the front vs. the back batting shoulder (8.2% vs. 6.2%; $P = 0.031$) with similar days missed (20.7 vs. 22.2; $P = 0.333$) and return to play rates (94.0% vs. 92.2%; $P = 0.135$).

CONCLUSION: Shoulder injuries affect a high number of professional batters, with 3,414 injuries and 68,808 days missed over the 6 seasons investigated. Labral tears were the most frequent season-ending injury and had the highest subsequent need for surgical intervention. Of the shoulders, the front batting shoulder was found to be most at risk for surgery relative to the back batting shoulder. An understanding of these injury patterns experienced by professional batters may allow for more accurate prognostic evaluations for these athletes, and can serve as an important benchmark to be used for future preventative measures.

Poster 61

ACL Reconstruction Does Not Impact Career Earnings Following RTP in National Basketball Association Athletes

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PURPOSE: To quantify the financial impact of an anterior cruciate ligament (ACL) injury on the remaining career earnings of National Basketball Association (NBA) players.

METHODS: A retrospective review was performed for all NBA players who suffered an ACL rupture between 2000 and 2019. Players were matched to health controls by age, position, body mass index, and player efficiency rating (PER) at the time of injury (index year). Player information collected included demographic information, position, team role, draft pick, date of injury, contract length and earnings during the three years prior and seven years following the index year, as well as new contract length and earnings following injury.

RESULTS: A total of 12 (22%) players did not return to play (RTP). There was no statistically significant difference in annual earnings present at any time point between cohorts. When examining the mean difference in earnings between the first three post index seasons and the three pre index seasons, both the ACL and control cohorts saw increased salaries as their careers progressed, without a significant difference in earnings. When comparing cohorts, there was no significant difference found in the length and earnings of contracts during the index year. Furthermore, there was no significant difference found in the length or earnings of the first new contract signed after index year between cohorts. Additionally, NBA players who RTP following ACL reconstruction were more likely to experience increased earnings if they had greater experience and performance prior to their injury ($p < 0.01$).

CONCLUSION: Our study found that NBA players did not experience diminished earnings following RTP from an ACL reconstruction when compared to matched controls. Furthermore, there were no differences seen in the length of new contracts, or contract earnings between cohorts. Players with greater experience and performance prior to injury were more likely to have increased earnings following ACL reconstruction.

Poster 62

NHL Player Workload and Performance Following Arthroscopic Shoulder Labral Repair

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PURPOSE: To investigate the impact of arthroscopic shoulder labral repair on career longevity, game utilization, and performance of National Hockey League (NHL) athletes.

METHODS: A retrospective review of all NHL players who underwent arthroscopic shoulder labral repair from 2004-2020 was performed. A 2:1 matched control group was used for comparison. Controls were matched by age, BMI, position, and experience prior to the index year. Demographic characteristics, game utilization, and performance metrics were collected for all athletes. Statistical analysis examined game utilization and performance both at one-year and three-year follow-up compared to one season before injury.

RESULTS: Twenty-nine players who underwent arthroscopic shoulder labral surgery returned to play (100% RTP) and were matched with 55 control players. The operative cohort experienced shorter careers compared to controls (4.4 ± 3.1 vs. 6.0 ± 3.6 seasons, $p \leq 0.05$). After one season, injured players experienced significant reductions in goals per 60 (0.6 ± 0.4 vs. 0.8 ± 0.5 , $p < 0.01$), points per 60 (1.5 ± 0.9 vs. 2.0 ± 0.9 , $p < 0.01$), and shooting %, (8.5 ± 5.8 vs. 10.5 ± 5.2 , $p = 0.02$) compared to the year prior. The reduction in goals (0.6 ± 0.4 vs. 0.8 ± 0.5 , $p = 0.01$) and shooting % (8.5 ± 4.7 vs. 10.5 ± 5.2 , $p = 0.04$) persisted at three-year. Compared to controls, the surgical group experienced significant reductions at one season post-index in percentage of goals, assists, points per 60 and shooting percentage. Only the reduction in goals per 60 persisted at three seasons post index.

CONCLUSION: Following RTP after arthroscopic shoulder repair, NHL players demonstrated reduced career longevity compared to healthy controls. Players exhibited significant reductions in game utilization and performance at one season after injury, but returned closer to baseline after three seasons.

Poster 63

Central Compartment Bone Marrow Stimulation During Hip Arthroplasty: Surgical Technique

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BACKGROUND: Bone marrow stimulation has a well-established clinical history in knee arthroscopy and the treatment of meniscal injury. In knee literature, bone marrow stimulation has been proven effective in helping increase the healing rates of meniscal repair. The principle aim of these techniques is to promote healing of the meniscal injury by enhancing the micro-environment within the joint.

While these techniques have been shown to increase healing of meniscal tears in knee arthroscopy, an analogous procedure has not yet been documented or demonstrated in hip arthroscopy. Here, we present two techniques for bone marrow stimulation during hip arthroscopy with labral repair: with a shaver and with a microfracture pick.

DESCRIPTION OF TECHNIQUE: After establishing arthroscopic access to the hip joint in standard fashion with the hip extended, adducted, internally rotated and under traction, the central compartment can be effectively viewed from an anterolateral (AL) portal. This standard view allows visualization of the acetabular cartilage, fovea, and ligamentum teres.

A coblation device is inserted through a mid-anterior (MA) portal canula and advanced through the central compartment into the fovea. Being careful not to damage the articular cartilage, soft tissue can also be cleared from the fovea. Alternatively, the shaver can be used on oscillate to clear soft tissue from the edge of the fovea.

Once this area has been prepared, the shaver can be turned on forward and used to create a small bed of bleeding bone. Alternatively, a bleeding surface can be prepared with use of a microfracture pick through the same MA portal.

RESULTS: Use of these techniques allows for effective development of a bleeding bony bed in the central compartment of the hip without damaging the surrounding cartilage. This is an effective way to increase the biologic milieu in and around the central compartment and thereby increase healing of chondrolabral pathologies. While these techniques have been demonstrated to increase healing rates of meniscal tears, they have not been studied in hip arthroscopy and labral repair. Further study is necessary to evaluate clinical effectiveness of this technique.

CONCLUSIONS: Here we demonstrate three techniques for bone marrow stimulation within the central compartment during hip arthroscopy to stimulate an increased biologic response and help in tissue healing.

Poster 64

Shoulder Arthroplasty in Patients with Juvenile Idiopathic Arthritis: Long-Term Outcomes

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BACKGROUND: Juvenile idiopathic arthritis (JIA) is the most common chronic rheumatologic disease that occurs in the pediatric population. Often, JIA continues throughout life leading to progressive polyarticular arthritis and significant joint destruction and disability, frequently requiring replacement surgery. This study aimed to determine the outcomes of primary shoulder arthroplasty (SA) in patients with JIA.

METHODS: Over a 42 year time period (1977-2019), 67 primary SA (20 hemiarthroplasty (HA), 38 anatomic total shoulder arthroplasty (TSA), and 9 reverse shoulder arthroplasty (RSA)) with a prior diagnosis of JIA formally established in a multi-disciplinary rheumatologic clinic met inclusion criteria. Further assessment was performed with inclusion of the visual analog scale (VAS) pain score, active shoulder range of motion (ROM), imaging studies, complications, and implant survivorship free from reoperation and revision.

RESULTS: SA led to substantial improvements in pain and ROM across the entire cohort at an average follow-up period of 12.2 years (range, 2– 34 years). TSA was associated with the lowest pain scores (0.8; $p = 0.02$) and the highest ASES scores (77.4; $p = 0.04$) at most recent follow-up when compared to HA and RSA. There were 14 (21%) complications across the cohort with rotator cuff failure ($n = 4$; 5.9%) as the most common complication followed by infection ($n = 3$; 4.5%). Revision surgery was performed in 5 shoulders (7.5%), with five-year implant survival rates of 95.1% at five years, 93% at ten years, 89.4% at twenty years, and 79.5% at thirty years. At 30 years, TSA was associated with better survival (90.1%) when compared with HA (71.8%).

CONCLUSION: Primary shoulder arthroplasty in the form of HA, TSA, and RSA offers a reliable surgical option for JIA patients with respect to pain reduction and ROM improvements. Unique challenges still exist in this cohort, in particular younger patients with an elevated propensity for glenoid bone erosion and a complication rate of 20.9%. As such, HA may not be ideal in this patient population. However, despite rotator cuff and glenoid concerns, TSA seems to be associated with better pain relief and patient reported outcomes with the most durability in the long term when compared to HA.

Poster 65

Emergency Department Utilization Following Elective Outpatient Rotator Cuff Repair

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INTRODUCTION: Outpatient rotator cuff surgery has been shown to decrease cost of care by nearly 43% while not significantly altering the rate of readmission compared to those performed in an inpatient setting. However, inpatient readmission rates have been noted to underestimate overall healthcare utilization and cost of care as they do not account for patients who have been evaluated in the emergency department (ED) during the postoperative period. The purpose of this study was to identify the utilization rate and the most common reasons for presentation to the ED following elective outpatient rotator cuff repair and determine preoperative risk factors for these ED visits.

METHODS: Patients who underwent outpatient elective rotator cuff repairs between 2014-2015 were retrospectively evaluated utilizing the New York and Florida State Ambulatory Surgery and Services Database, State Inpatient Database, and State Emergency Department Database via the United States Agency for Healthcare Research and Quality's Healthcare Cost and Utilization Project. The primary outcome was all-cause 7- and 30-day ED utilization rates. Reasons for presentation to the ED were recorded and stratified. Univariate and multivariate analyses were performed to identify independent predictors of ED utilization.

RESULTS: The 7-day and 30-day ED visit rates were 3.2% and 5.0%, respectively. The most common cause for an ED visit after outpatient rotator cuff repair at 7- and 30-days postoperatively were postoperative pain (29.0%) and GI complaints (16.3%), respectively. African American race (Odds Ratio (OD), 1.69; confidence interval (CI), 1.29-2.18; $p < 0.001$), Hispanic race (OD, 1.47; CI, 1.11-1.91; $p = 0.005$) and comorbid diagnoses of hypertension (OD, 1.51; CI, 1.26-1.80; $p < 0.001$), diabetes (OD, 1.58; CI, 1.23-2.00; $p < 0.001$), and/or schizophrenia (OD, 5.14; CI, 2.39-10.1; $p < 0.001$) were independent risk factors for an ED visit at up to 30 days postoperatively. Those with Medicare (OD, 2.01; CI, 1.61-2.50; $p < 0.001$) or Medicaid (OD, 2.61; CI, 1.90-3.54; $p < 0.001$) were more than twice as likely to present to the ED within 30 days than those with private health insurance.

CONCLUSION: ED utilization following outpatient rotator cuff repair is low, with postoperative pain being the most common cause for an ED visit within seven days postoperatively. While nearly one-fifth of patients seen in the ED required an inpatient stay by 30 days postoperatively, 97% of patients presenting to the ED for postoperative pain were subsequently discharged home.

Poster 66

The Impact of Post-9/11 Airport Security Measures on Patients with Anatomic and Reverse Total Shoulder Arthroplasties

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BACKGROUND: Advancements in airport screening measures in response to 9/11 have resulted in increased false alarm rates for patients with orthopedic and metal implants. With the implementation of millimeter-wave scanning technology, it is important to assess how the airport screening experiences of patients with total shoulder arthroplasties (TSA) have changed.

METHODS: 197 patients with prior anatomic and reverse TSA completed between 2013-2020 responded to a questionnaire regarding their experiences with airport travel screening after their operation. Of these patients, 86 (44%) stated they had traveled by plane while 111 (56%) had not. The questionnaire addressed several measures including the number of domestic and international flights following the operation, number of false alarm screenings by the millimeter-wave scanner, patient body habitus, and presence of additional metal implants.

RESULTS: A total of 53 patients (61.63%) responded 'yes' to false screening alarms due to shoulder arthroplasty. The odds of a false screening alarm for patients with other metal implants are 5.87 times the odds of a false screening alarm for patients with no other metal implants ($p < 0.1$). Patient sex ($p = 0.27$), patient age ($p = 0.32$), type of shoulder arthroplasty ($p = 0.85$), international travel since shoulder arthroplasty ($p = 0.64$), TSA Pre-Check use since shoulder arthroplasty ($p = 0.38$) and use of a physician note ($p = 0.40$) had no significant effect on odds of experiencing false alarms. Out of a reported 662 total flights, 303 (45.77%) resulted in false screening alarms. Receiver operating characteristic (ROC) analysis did not demonstrate a significant effect of body mass index (BMI) on triggering false screening alarms ($p = 0.30$).

CONCLUSION: Patients with anatomic and reverse TSA trigger false alarms with millimeter-wave scanners during airport screening at rates consistent with prior reports following 9/11. Improvements in implant identification during airport screening may help improve patient travel experiences.

Poster 67

Cost and Performance after SLAP Repair in Major League Baseball Pitchers

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INTRODUCTION: Superior labrum anterior posterior tears (SLAP) can be career altering injuries for Major League Baseball (MLB) pitchers. Surgery and postoperative rehabilitation retain pitchers on the injured list (IL) for an extended period of time. To date, no analyses have focused on the financial cost of SLAP repairs in major league baseball.

METHODS: A retrospective review of SLAP injuries from 2004-2019 was conducted utilizing the injured list and financial contract data from the MLB website. Overall cost of SLAP injury was calculated through a previously established formula based on daily salary of the injured player and added cost of the replacement player. The injured player's annual salary is divided by 182-day season and multiplied by the number of days spent on the IL. Additional costs of the replacement player are prorated, daily salary was based on the league minimum for that specific year of injury. Performance metrics averages for earned run average (ERA), walks + hits per inning pitched (WHIP), and innings pitched (IP), were compared before and after the injury.

RESULTS: Fifty-five players were identified on the IL who underwent a SLAP repair. The mean annual cost of placing a pitcher on the IL was \$424,282. Injured players spent an average of 172 days per year after SLAP repair. Over the studied period, results did not show a significant trend for average cost of SLAP injuries ($R^2 = 0.288$; $p = 0.29$) or average days spent on the IL per year ($R^2 = 0.001$; $p = 0.9$). Performance metrics showed significant differences pre- and post-injury for ERA (4.49 vs. 3.16; $p = 0.03$) and IP (320.6 vs. 296.5; $p = 0.03$).

CONCLUSION: SLAP injuries in MLB pitchers have an extended amount of time spent on the disabled list which leads to substantial financial impact of over \$20 million. Although these injuries can be costly in terms of both time and money, it is encouraging to know that players did not suffer, but even improved their sports performance after SLAP repairs. Our findings highlight the need for education and preventative measures with SLAP injuries in high-performing pitchers.

Poster 68

Determinants of Physical Therapy Utilization Following Shoulder Surgery - Do Cost and Coverage Matter?

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BACKGROUND: Postoperative physical therapy (PT) is a cornerstone for patients to achieve optimal range of motion and better overall patient-centered outcomes following orthopedic shoulder surgery. Access to postoperative PT can be limited by insurance type, coverage, social determinants, and cost. Healthcare costs pose a significant problem in the United States and a 2007 survey found that 70 million Americans owe medical debt or have difficulty paying for treatment. The purpose of this study was to evaluate factors that impact the use of physical therapy for patients undergoing shoulder surgery.

METHODS: This was a retrospective analysis of 80 patients that underwent shoulder surgery with physical therapy sessions postoperatively. The patients were divided based on insurance type: privately insured (PI) and Medicare with or without supplemental insurance (MI). Data collected included demographics, comorbidities, diagnosis, copay, total and postoperative number of sessions utilized. Statistical analysis included independent t-test, chi-square, and a multinomial logistic regression based on copay.

RESULTS: The cohort contained 53 females to 27 males with an average age of 61.7 years and BMI of 27.95. When divided by insurance type, there were no significant differences between groups at baseline other than age, where the MSI group was older (69 vs. 56 years; $p < 0.01$). Those in the PI group were more likely to have copayment ($p < 0.01$). There was no significant difference between the two groups in the number of utilized total and postoperative PT sessions. The cohort was then divided into copay (CP) and no copay (NCP) groups. Patients in CP group more often had private insurance, while NCP more often had Medicare ($p = 0.018$). CP had significantly more total PT visits than NCP ($p = 0.046$). The regression model showed copayment is not independently associated with a change in the number of PT visits, however, there was a trend towards having more total PT visits when there is a copayment.

CONCLUSION: PT utilization was not influenced by insurance type, as determined by number of PT sessions attended. However, having copayment was associated with having more PT visits. It appears that a financial investment into rehabilitation may increase compliance and utilization for patients during postoperative rehabilitation after shoulder surgery.

SUMMARY: Financial investment into rehabilitation may increase compliance and utilization for patients during postoperative rehabilitations after shoulder surgery.

Poster 69

Does Insurance Status Predict Magnitude of Rotator Cuff Tear at First Presentation to an Orthopedic Surgeon?

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INTRODUCTION: Chronicity of a rotator cuff tear (RCT) may play an important factor when considering treatment options. Prior studies have shown that repairing chronic tears with increased fatty infiltration leads to worse outcomes. Many factors may delay treatment of RCTs, including access to care based upon insurance status. The purpose of this study was to evaluate the relationship between RCT magnitude on presentation and insurance status. We hypothesize that those with Medicaid insurance will have larger tears with greater fatty infiltration upon initial presentation.

METHODS: Patients presenting with RCTs from 2005 to 2019 were identified and included in this study. Demographic data including age, race, sex, and insurance carrier were collected via chart analysis. Individual MRIs were reviewed by a board-certified musculoskeletal radiologist to evaluate supraspinatus (SS), infraspinatus (IS), subscapularis (SSc), and biceps tendon (BT) tear magnitude. In addition, the presence of atrophy was evaluated using the scapular ratio. Analyses compared differences between public and private insurance groups, using Chi Square tests. Significance was established at $p < 0.05$.

RESULTS: Of the 492 patients in this study, 192 had private insurance, 284 had public insurance (Medicaid: 33, Medicare: 247), and 16 were uninsured. Those with public/charity insurance presented with greater frequency of subscapularis and bicep tendon atrophy compared to those with private insurance (SSc $P = 0.003$, BT $P = 0.001$).

CONCLUSION: Patients with public insurance were more likely to present with SSc atrophy and BT tearing compared to patients with private insurance. This study suggests that insurance status may serve as a barrier to receiving timely treatment for a rotator cuff tear.

Poster 70

Diagnosing Septic Arthritis of the Native Shoulder Joint: A Systematic Review

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BACKGROUND: Septic arthritis of the native shoulder is associated with significant morbidity, especially in the setting of delayed diagnosis. Methods used to diagnose shoulder sepsis vary substantially, leading to potential underdiagnosis and undertreatment of patients. The purpose of this study was to conduct a systematic review investigating current strategies used to diagnose native shoulder joint sepsis.

METHODS: PubMed/MEDLINE, Scopus, and the Cochrane Library were used in the systematic literature search from January 1, 1960, through January 23, 2021. Data extraction and reporting were in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The Methodological Index for Non-Randomized Studies (MINORS) criteria guided the assessment of the quality of included studies. The primary outcome was to report on the synovial white cell count of patients with native shoulder sepsis. Descriptive statistics using percentages, means, and intraclass correlation coefficient (ICC) values were used to summarize the results.

RESULTS: This systematic review identified 31 studies, including 25 case series, 1 case control, and 5 cohort studies with a total of 7,447 native shoulder joints. There was no standardized approach to diagnosing septic arthritis of the shoulder. Combinations of patient symptoms, preoperative and intraoperative aspiration laboratory values, and imaging results were used to confirm the diagnosis. Ten studies reported on synovial white cell count with the majority yielding aspiration counts greater than 50,000 cells/ml, although one study was as low as 30,000 cells/ml.

CONCLUSION: Native shoulder joint sepsis diagnosis lacks uniformity. Modalities used to evaluate shoulder sepsis are heterogeneous and may lead to delays in diagnosis with devastating sequelae. Symptoms, comorbidities, and preoperative laboratory values are comparable to other human joints. Synovial white cell count is underutilized and may also present with a lower value than expected. Imaging trends reveal that MRI may better evaluate and guide management.

LEVEL OF EVIDENCE: Level IV; Systematic Review

Poster 71

Use of a Nanofiber Resorbable Scaffold During Rotator Cuff Repair: Surgical Technique and Retrospective Case Series Report

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BACKGROUND: The rate of retear after primary rotator cuff failure still remains unacceptably high with rates up to 90% reported in the literature. Augmentation of cuff repair with scaffold devices have been reported to improve healing after cuff repair. The purpose of this study is to describe the surgical technique of using an interpositional nanofiber scaffold during rotator cuff repair and to report on a retrospective series of patients regarding functional outcomes and postoperative healing on MRI. We hypothesize that augmentation of cuff repair with an interpositional scaffold results in high rate of tendon healing and excellent functional outcomes.

METHODS: Thirty-six patients underwent arthroscopic rotator cuff repair augmented with a nanofiber, bioresorbable polymer patch secured as an inlay between the tendon and underlying bone. Patients were evaluated with preoperative and postoperative outcome measures, including the Simple Shoulder Test, American Shoulder and Elbow Surgeons shoulder score, and active range of motion. Postoperative magnetic resonance imaging was used to evaluate repair status.

RESULTS: Patients showed significant improvement in Simple Shoulder Test and American Shoulder and Elbow Surgeons shoulder score at minimum 9 months postoperative follow-up ($P < 0.0001$). Range of motion in forward flexion, abduction, internal rotation, and external rotation was significantly improved at 6 months postoperatively ($P < .05$). Magnetic resonance imaging at average 10.5 months postoperatively showed healing in 95%; one patient had a recurrent tear with trans-tendon failure and a second had retear at the insertional site. The patch was not visible on postoperative imaging, suggesting complete resorption postoperatively in all patients. There were no adverse events associated with the patch such as fibrosis or mechanical symptoms.

CONCLUSION: Our results demonstrate preliminary safety and efficacy of a novel, bioresorbable synthetic scaffold for rotator cuff repair. Use of the scaffold resulted in 95% tendon healing rate and significant improvements in functional and patient-reported outcome measures. The surgical technique for placement of these scaffolds is critical to ensuring improvement in final outcomes, as described in this paper. The results are promising for improving the current unacceptably high rate of rotator cuff repair failure.

Poster 72

Healthcare Disparities in Surgical Treatment of Rotator Cuff Disease

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BACKGROUND: Healthcare disparities are a multifaceted problem and have been well-documented in literature to affect care and recovery following surgery. Insurance type is regularly cited by orthopedic surgeons to play a role in the incongruences faced by patients in the perioperative period. Recent trends highlight an increased reluctance by some insurance companies to approve indicated surgery. In an effort to provide greater awareness of this issue, our primary objective was to assess insurance type and how it affects approval rates for rotator cuff debridement and rotator cuff repair.

METHODS: A retrospective review of 999 patients that underwent rotator cuff debridement and repair between January 2015 and February 2020 was conducted. Data abstraction included demographics, prior surgical and nonsurgical interventions, radiologic imaging, insurance type, and denial of insurance coverage. Patients were further grouped by insurance type—Medicaid, Medicare, Worker's Compensation, and Private insurance—and assessed for statistical significance using one-way analysis of variance for age and chi-square or Fisher's exact test for all other comparisons. Univariable and multivariable logistic regression models were developed to estimate odds ratios for insurance type associated with the denial of insurance coverage.

RESULTS: 997 patients were included in our final analysis. Those with Private insurance were more likely to be Non-Hispanic White (71%), while the proportion of Hispanics was highest among Worker's Compensation (27%) and Medicaid (20%). There were no significant differences by insurance type for prior nonsurgical interventions and radiologic imaging. For previous surgical interventions (13%), however, rates were higher for Medicaid (18%) and Worker's Compensation (17%) compared to Medicare (12%) and Private insurance (9%) ($p = 0.003$). Compared to Private insurance, the odds of insurance denial were significantly higher for those with Medicaid at 54% (OR: 7.91, 95% CI: 5.27-11.88, $p < 0.001$) and Worker's Compensation at 19% (OR: 1.71, 95% CI: 1.04-2.81, $p = 0.04$).

CONCLUSION: One in two patients with Medicaid coverage faces insurance denial when compared to any other insurance type. Worker's Compensation follows with the second highest rates of denial. Amongst the different ethnic groups in our study, almost half the Hispanic population are insured by either Medicaid or Worker's Compensation and face unnecessary barriers to care that can negatively impact patient outcomes and complication rates. The main goal of our healthcare system should be to provide quality and timely care to patients that are in need, regardless of their insurance type.

Poster 73

The Use of Preoperative Planning to Decrease Costs and Increase Efficiency in the OR

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BACKGROUND: Shoulder arthroplasty (SA) has been shown to incur up to \$1.8B annually in societal costs. With increasing demand for SA and the steady decrease of annual reimbursements for orthopedic procedures, it is crucial to control costs. In SA there has been interest in using preoperative planning software to improve accuracy in positioning and implant selection to optimize outcomes. However, the use of preoperative planning to increase efficiency has not been studied. The purpose of this study was to determine if preoperative planning could increase efficiency and decrease costs in the operating room.

METHODS: This retrospective review included 94 patients who underwent shoulder arthroplasty and had a CT scan with a preoperative plan by a single orthopedic surgeon between 2017-2020. The patients were divided into two groups based on the use of the preoperative plan during surgery. Group 1 included 28 patients who underwent SA without a preoperative plan utilized during surgery and group 2 included 66 patients with a preoperative plan used during surgery. Procedure time, number of trays sterilized, and postoperative outcomes were compared and statistical analyses were performed. Sub-analysis was done to find a statistical difference in the cost of sterilization for both groups.

RESULTS: The cohort had 55% males with an average age of 71 and average BMI of 29.9. There were no significant differences between groups for age, BMI, nor ASA class. There was no significant difference between groups in average operative time (119.7 minutes for group 1, 111.8 minutes for group 2 ($p = 0.87$)) or average time in the OR (173.2 minutes for group 1, 183.6 minutes for group 2 ($p = 0.87$)). However, there was a significant difference in average trays prepared and sterilized between the groups (5.6 trays for group 1, 4.8 trays for group 2 ($p < 0.0005$)). This yielded a significant difference in cost of sterilization between the groups with group 1 costing on average an additional 17% ($p < 0.0005$). There were no significant differences in postoperative outcomes.

CONCLUSION: While preoperative planning did not reduce time in the OR for shoulder arthroplasty, it was correlated to a significant reduction in the number and cost of sterilized trays with comparable postoperative outcomes. Better cost data and transparency for future studies will further elucidate the cost impact of preoperative planning in the OR. With decreasing reimbursement for orthopedic surgery, administrators and physicians must find more tools to control operating costs.

Poster 74

Analysis of Compliance with Patient-Reported Outcomes Collection in a Private Practice Electronic Outcomes Database

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BACKGROUND: Patient reported outcome measures (PROMs) have become an important data set collected and stored in orthopedic registries. The use of PROMs in orthopedics offers a way to better measure surgical outcomes and will likely contribute to value-based care models in the future. While significant resources are required to implement and maintain a registry, recent literature suggests that compliance with PROMs is low in arthroscopy registries. Since patient compliance with PROMs is tracked via electronic notifications, our aim is to identify patient-specific characteristics and risk factors that might contribute to noncompliance with PROMs following shoulder arthroscopy.

METHODS: We performed a retrospective review of outcome reporting data from a cohort of 225 patients who underwent arthroscopic shoulder surgery by a single surgeon in a private practice setting from June 2017-June 2019. Patient compliance with PROMs was calculated at preoperative, three-month, six-month, one-year, and two-year follow-up time points. Compliance was defined as a complete patient response to the assigned outcome module for their procedure logged in the Surgical Outcomes System database at each individual time point. Statistical analysis was performed to compare differences between the responders and non-responders.

RESULTS: The median age at time of surgery was 57 years with an interquartile range of 48 to 66 years. Most patients in the study population were white (84%), and a notable percentage of patients self-identified as Hispanic or Latino (34%). Compliance with PROMs was highest preoperatively (91.1%) and decreased at subsequent time points. The largest decrease in compliance with PROMs occurred between the preoperative and three-month follow-up time points. Overall, 36% of patients were compliant at all individual time points. There were no significant predictors of follow-up with regard to age, sex, race, ethnicity, or procedure.

CONCLUSION: Patient compliance with PROMs decreases over time with the lowest percentage of patients completing electronic surveys at the traditional two-year follow-up for shoulder arthroscopy. Our findings suggest that basic demographic factors are not predictive of patient compliance with PROMs, and further study is necessary to identify strategies to improve compliance. Despite electronic notifications and integration into our practice electronic medical record, compliance rates at two-year follow-up remain below the acceptable loss of follow-up for orthopedic research.

Poster 75

Objective Sleep Assessment in Patients with Rotator Cuff Disease: A Prospective Study

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INTRODUCTION: Nocturnal shoulder pain is hypothesized to have a negative effect on sleep latency, duration, and quality. While this relationship has been described through subjective means in the past, objective data on this topic is limited in orthopedic literature. In this study, we use continuously worn activity monitors to assess the relationship between rotator cuff disease and sleep quality.

METHODS: Patients with full- or high-grade partial thickness rotator cuff tears were prospectively enrolled in our study between 2018 and 2020. Study participants were given waist-worn accelerometers to wear continuously for 14 days and were instructed to record the beginning and end of the sleep cycle using an event marker. Shoulder MRIs were reviewed by three independent graders (one fellowship-trained shoulder and elbow surgeon and two orthopedic surgery residents) and the Patte Classification was used to stage rotator cuff tendon retraction. A preliminary analysis comparing the frequency of event-marker button presses and mode Patte Classification was conducted by our institution's biostatistics and public health departments.

RESULTS: A total of 40 participants were enrolled in the study, and 31 had complete activity datasets to allow inclusion in the preliminary analysis. 52% of our study cohort was female with a mean age and BMI of 59 ± 6.8 years and 32.8 ± 6.2 kg/m², respectively. 48.4% (15 participants) of our cohort had Patte stage I disease, 41.9 % (13 participants) had Patte stage II disease, and 9.7 % (3 participants) had Patte stage III disease. Due to the unequal variances and/or unequal sample sizes, a Welch's ANOVA was used to assess differences between the frequencies of event-marker presses. No statistically significant difference in sleep quality and quantity was seen between the three groups ($p = 0.159$).

CONCLUSIONS: Our preliminary analysis indicates that there is no statistically significant difference in the raw number of event-maker presses amongst patients with Patte stage I, II, and III disease. Additional analysis including comparison to age-matched controls, and assessment of patient activity and energy expenditure is on-going. The results from our study can have important implications in guiding the early surgical management of patients with symptomatic full- or high-grade partial thickness rotator cuff tears, especially in those with significant impairment to sleep quality.

Poster 76

The Effect of Physical Therapy and Rehabilitation Timing on Rotator Cuff Repair Revisions and Capsulitis.

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INTRODUCTION: Rotator cuff repair (RCR) historically has a relatively high reported retear rate (13-43% depending on the study). One variable that could potentially affect retear rate is the timing of beginning physical therapy after RCR. There are two main protocols for this rehabilitation: early passive range of motion (EPM) and delayed passive range of motion (DPM). While many studies have demonstrated decreased stiffness with an EPM protocol, studies have also shown that EPM may increase retear rates. The goal of this study was to identify reoperation and capsulitis rates after RCR in an available database and determine if there was an association with the timing of physical therapy post-RCR.

METHODS: Medicare patients within the PearlDiver database who underwent an open or arthroscopic RCR were stratified based on the timing of their first physical therapy session postoperatively. Patients lacking a laterality modifier for the RCR procedure or patients who were not active in the database for at least one year following primary RCR were excluded. Reoperation and capsulitis rates were determined amongst the different timings of beginning of physical therapy. Demographics and comorbidities of the cohort were also used in a univariate analysis for reoperation rate. Variables demonstrating significance in this univariate analysis were included in a multivariate analysis for reoperation rate.

RESULTS: The cohort consisted of 64,662 patients who underwent RCR and started physical therapy within 13 weeks of surgery. Starting physical therapy within 1 week postoperatively resulted in a significantly higher reoperation rate compared to starting physical therapy in weeks 2-5, 6-9, or 10-13 (7.7% vs. 3.7% amongst all other groups, $p = 0.002$). There was no significant difference between the groups beginning physical therapy in weeks 2-5, 6-9, or 10-13. The univariate and multivariate analysis for reoperation demonstrated that starting physical therapy within 1 week postoperatively was associated with a significantly higher rate of reoperation compared to beginning physical therapy after 1 week ($OR = 2.235$, $p < 0.001$). There was no association between timing of beginning physical therapy and capsulitis rates.

DISCUSSION: In the Medicare patient population, beginning physical therapy within one week postoperatively was associated with a significantly higher reoperation rate; however, there was no associated benefit in capsulitis rates for beginning physical therapy early. This calls into question the use of an EPM protocol for older patient populations; however, further studies should be completed to conclusively determine the most efficacious time to begin rehabilitation post-RCR.

Poster 77

A Radiological Evaluation of Clinical Outcomes in Patients Undergoing Subacromial Decompression for Subacromial Impingement Syndrome

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PURPOSE: To determine in patients with subacromial impingement syndrome (SAIS): (1) the relationship between clinical symptoms evaluated with the Constant score and morphological findings seen on radiographs and magnetic resonance imaging (MRI), and (2) to determine any correlation between radiologic findings and the improvement of subacromial decompression outcomes, evaluated using pre- and postoperative Constant scores and clinical outcomes.

METHODS: Retrospective chart analysis was performed on all patients and radiographs and MRIs collected before the time of surgery were analyzed for acromiohumeral distance, critical shoulder angle, lateral acromial angle and acromial shape, index, slope, and tilt. The Constant score was calculated pre- and postoperatively (at average five months after surgery) to evaluate for changes in clinical symptoms. Spearman or Pearson correlation coefficients were used as appropriate with a 95% confidence interval and descriptive statistics were obtained.

RESULTS: This study included 20 consecutive patients of a single orthopedic surgeon (10 male, 10 female; mean age, 51.4 years) who underwent subacromial decompression for SAIS, after failing conservative therapy. The preoperative and postoperative Constant score were not significantly correlated with any radiological findings. Preoperative sleep disturbance was significantly correlated to radiographic acromiohumeral distance ($r^2 = 0.725$, $P = 0.021$) and postoperative sleep disturbance was significantly correlated to the radiographic acromial index ($r^2 = -0.402$, $P = 0.039$) and the lateral angle of the acromion ($r^2 = 0.500$, $P = 0.012$). No MRI findings were significantly correlated with the preoperative or postoperative Constant score or sleep disturbances. There was a significant improvement in mean Constant score for all patients following subacromial decompression (pre = 69.45, post = 81.15) which correlated positively with post-surgical outcomes ($r^2 = 0.563$, $P = 0.010$).

CONCLUSION: While radiographs and MRIs provide useful information to narrow the differential diagnosis and assist with surgical planning, none of the anatomical variables assessed were predictive for improvement of patient outcomes following subacromial decompression. Preoperatively, acromiohumeral distance may be associated with increased sleep disturbances, while postoperatively acromial index may be associated with decreased sleep disturbance and the lateral angle of the acromion associated with increased sleep disturbances. This may suggest that acromial morphology and the underlying subacromial space play a significant role in the sleep quality of patients with SAIS. Subacromial decompression was associated with an overall increase in Constant score and was significantly correlated with improvement in surgical outcomes. There was no preoperative radiologic correlation with postoperative clinical outcomes.

Poster 78

The Fate of Distal Biceps Partial Thickness Tears

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BACKGROUND: Distal biceps tendon tears, although rare, significantly impair patient's elbow mobility and function. There is a paucity of literature reporting outcomes of partial thickness tears to inform management strategies. Therefore, the authors sought to identify magnetic resonance imaging (MRI) confirmed partial thickness distal biceps tears and report on (1) demographics and treatment strategies, (2) outcomes and complications, and (3) any identifiable risk factors for progression to surgery or full thickness tear.

METHODS: Patients who experienced a partial thickness distal biceps tear confirmed on MRI from 1996 to 2016 were identified by a musculoskeletal radiologist through an institutional image database. Patients were included if they had complete medical records and at least one visit of clinical follow-up. Patients with inflammatory arthritis and enthesitis, polytrauma, or incidental findings without clinical assessment were excluded. Medical records were reviewed to confirm the diagnosis and obtain study details. Multivariate logistic regression models were created using baseline patient characteristics, injury details, and physical exam findings in order to predict operative intervention.

RESULTS: Overall, 111 patients (22F, 89M, age: 53.6 years \pm 13) were identified and included. Baseline injury characteristics, including weakness in elbow flexion, forearm supination, and patient reported sensation at time of injury, were all found to be statistically different between treatment groups. Patients were found to have a mean clinical follow-up time of 10 years. Nonoperative treatment was employed for 57 patients and 54 were treated operatively. Patient outcomes differed only in time missed from work, with operative patients missing more time. There were 5 re-operations (9%), 3 re-ruptures (6%), and overall, 31% of the operatively treated cohort experienced a complication. Supination weakness at initial consult was found to be a predictor for surgical intervention.

CONCLUSIONS: Operative patients tended to be male with more profound supination weakness; these patients returned to work later, but showed more weakness with elbow flexion and supination strength preoperatively. At 10-year clinical follow-up, 31% experienced some complication and 9% underwent a re-operation. Patients should be counseled that operative intervention represents a balance of delayed return to work and possibly less weakness with elbow flexion and supination at the expense of increased complications.

Poster 79

Pelvic Insufficiency Fractures: A New Osteoporotic Defining Event Based on the American Own the Bone Registry

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INTRODUCTION: Sustaining an isolated pelvic insufficiency fracture (PIFX) does not currently result in a clinical diagnosis of osteoporosis. Consequently, these patients may not receive effective prevention of subsequent insufficiency fractures. The purpose of this study is to use the AOA Own the Bone (OTB) program registry to determine if an isolated PIFX should be an osteoporotic defining event.

METHODS: From 2009-2016, 31,059 patients over age 50 were analyzed. The first cohort included 1,573 patients who presented with isolated pelvic ring fractures without a concomitant hip and/or spine fracture. The second cohort included 29,486 patients who met current National Osteoporosis Foundation (NOF) diagnostic criteria for osteoporosis, but did not sustain a PIFX. Using multi-variable binary logistical regression, 36-bone health relevant variables encompassing demographics, medical history, lifestyle factors, and fracture-specific data were analyzed to compare the cohorts. Sensitivity and specificity were calculated to assess the predictive model.

RESULTS: Caucasian, postmenopausal women accounted for 83% of PIFX and one-third of patients presenting with a PIFX had a prior fracture after the age of 50 (31.5%). Our multi-variable binary logistic regression model revealed no identifiable differences between the two cohorts (sensitivity = 0.0%, specificity = 100.0%).

DISCUSSION: Based on our results, patients with an isolated PIFX are phenotypically identical to patients with a qualifying diagnosis of osteoporosis. Currently, certain fracture locations alone (i.e., hip or spine) are sufficient for diagnosis and initiation treatment that reduces subsequent fragility fractures by 50+%. These results suggest that PIFX warrant consideration for being an independent criterion for clinically diagnosing osteoporosis.

Poster 80

Technical Note on Placement of Low Profile Triangular Osteosynthesis for Unstable Posterior Pelvic Ring Injuries

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INTRODUCTION: Triangular osteosynthesis is a technique used to stabilize posterior pelvic ring injuries. It consists of unilateral pedicle screws placed into both L4 and L5, or just L5 connected to an iliac screw with a spinal rod construct. This is combined with iliosacral or trans-sacral screws to complete the triangle. Conventional triangular fixation can be problematic for several reasons, including the need for advanced skill sets to place instrumentation, difficulty with pelvic reduction and placing the connecting construct, and prominent instrumentation causing wound breakdown. The purpose of this study is twofold: (1) Description of a technique using implants that are easy to connect, allow distraction for complex lumbosacral displacements, and are placed in a location minimizing soft tissue prominence, and (2) to present our initial case series using this technique.

METHODS:

Technique: Patient is positioned prone and a 6cm Wiltse incision is used over L5 and S1. L5 pedicle Schanz screws are placed first, followed by another Schanz screw from the sacrum, across the SI joint, and into the ilium. Straight connecting rods are then placed and the construct is distracted as needed and tightened. This creates a low profile lumbopelvic construct that is easier to place than traditional fixation techniques.

Retrospective review: A review of 18 consecutively treated patients with this technique was also performed. Inclusion criteria were patients with complete disruption through the sacrum or sacroiliac joint from blunt trauma (AO/OTA type C injuries). Outcomes included pelvic reduction/malreduction, wound healing, and complications. Pelvic reduction was measured by the modified Keshishyan Index and superior migration of the hemipelvis on the Bonesetter APP (Detroit, MI, USA).

RESULTS: Fourteen patients underwent unilateral fixation (81%), and four patients underwent bilateral fixation (19%). All patients (18/18) had a well reduced pelvis after fixation. No patient (0%) required a return trip to the operating room for loss of reduction/malreduction, wound breakdown, or implant failure. All patients had at least one year of follow-up.

CONCLUSION: This study presents an updated technique for a low-profile triangular osteosynthesis construct with easier application for unstable posterior pelvic ring injuries. This technique does not require rod bending, results in a consistently more recessed iliac screw and connecting rod, and can be used in a wide variety of unstable posterior pelvic injuries, including comminuted sacral fractures, L5/S1 facet fractures, and vertical shear injuries.

Poster 81

A Comparison of Distal Femoral Replacement and Open Reduction-Internal Fixation for the Management of Periprosthetic Distal Femur Fractures

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OBJECTIVE: The incidence of periprosthetic distal femur fractures is on the rise as a direct result of the increasing number of total knee arthroplasties being performed. Recent reports have suggested that distal femoral replacement (DFR) may be superior to open reduction internal fixation (ORIF) when treating these fractures with the potential for immediate weightbearing and elimination of the risk of nonunion. The purpose of this study was to compare these two treatment modalities in terms of their revision rate, postoperative disposition, and cost.

METHODS: An institutional database was used to identify patients who underwent ORIF or DFR for periprosthetic distal femur fractures between 2014 and 2019 at a Level 1 trauma center. Medical records, radiographs, and hospital finance reports were reviewed for demographics, fracture classification, comorbidities, postoperative course, complications, and total cost of encounter. Patients were excluded for the presence of nondisplaced fractures and fractures associated with implant loosening. All patients were a minimum of one year from fracture treatment. Chi-squared tests and Student's t-tests were used to compare the two groups.

RESULTS: 75 patients (60 ORIF; 15 DFR) were included in this study. Fifteen patients were treated with DFR and 60 patients were treated with ORIF. There was no significant difference in average age, gender, smoking status, body mass index, Charlson comorbidity index, or injury severity score between the two groups. Patients who underwent DFR had \$57,689 greater in total encounter charges than the ORIF group. Neither treatment was associated with a higher rate of revision, infection, or mechanical complication, nor with a longer inpatient stay, ICU stay, operative time, or disposition to home rather than a rehabilitation facility (6.7% of patients for DFR vs 10.0% of patients for ORIF, $p>0.99$).

CONCLUSION: To our knowledge, this study is the first of its kind to evaluate the financial implications of the choice of DFR or ORIF for periprosthetic distal femur fractures alongside outcomes. The results demonstrate that despite the advantage of immediate weightbearing with DFR, there is no significant difference in discharge disposition or revision rate. While shared decision making in combination with surgeon experience should be used when deciding on a treatment modality for these injuries, it is important for clinicians to understand the financial implications of their treatment decisions given the central role they play in health care expenditures.

Poster 82

Unique Quadruple Disruption of Superior Shoulder Suspensory Complex with Associated Proximal Humerus Fracture-Dislocation

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BACKGROUND: The superior shoulder suspensory complex (SSSC) is made up of bony and soft tissue components that are fundamental in stabilizing the upper extremity. The SSSC is composed of the distal clavicle, coracoclavicular ligaments, coracoid process, glenoid process, spine of the scapula, acromion, and acromioclavicular (AC) ligaments. Disruptions of the SSSC are rare and associated with significant morbidity. These injuries typically result from high-impact collisions. We present a case of a patient with a quadruple disruption of the SSSC with associated proximal humerus fracture-dislocation requiring a three-stage reconstruction of the glenoid, scapula, proximal humerus, and AC joint.

CASE PRESENTATION: A 34-year-old male was a restrained passenger in a high-speed rollover motor vehicle crash. The patient was transported to a Level I trauma center and presented with a complex left upper extremity injury. The injury included a type 5 AC Joint Separation, comminuted intra-articular glenoid fracture with extension to the coracoid process base, displaced open scapular body fracture, posterior shoulder dislocation of the glenohumeral joint, and two-part proximal humerus fracture. To our knowledge, this is the first report describing this complex injury pattern involving the SSSC with an associated proximal humerus fracture-dislocation. The treatment plan included irrigation and debridement of the open fracture, followed by a three-stage reconstruction, including the scapula, the AC joint, and the proximal humerus.

CONCLUSION: A quadruple disruption of the SSSC is an extremely rare injury that warrants a tailored surgical approach to manage. These injuries may represent significant morbidity given their association with polytrauma, affecting the ability to recover postoperatively. We present the first documented case of a patient with a quadruple disruption coupled with a proximal humeral fracture-dislocation. Despite the complicated injury pattern, our treatment regimen led to a successful outcome with no complications.

Poster 83

Does Serum Procalcitonin Predict Fracture-Related Infection?

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INTRODUCTION: Serum procalcitonin (PCT) levels are useful for identifying systemic bacterial infections and predicting positive cultures in sepsis. Although PCT has been shown to be diagnostic and prognostic in diabetic foot infections, limited specificity in other applications has been demonstrated. There is still much to learn about PCT's utility with respect to diagnosing fracture-related infections (FRIs). We aimed to determine if serum PCT levels are elevated in patients meeting confirmatory FRI criteria compared to laboratory reference and matched patients with uncomplicated fractures.

METHODS: A diagnostic level III retrospective case-prospective control study was conducted for patients with postoperative fracture complications returning for intervention between 2017 and 2020. Those meeting confirmatory FRI criteria and who received preoperative serum PCT labs were included (cases). Exclusion criteria included confounding factors that could cause an increase in PCT levels. Case PCT levels were compared to laboratory reference values. Additionally, a group of matched patients with uncomplicated fractures were prospectively enrolled (controls). Controls were matched based on age, postoperative follow-up time, and fracture location. Demographic and injury data were abstracted. Control PCT levels were measured and compared to their respective matched case.

RESULTS: 30 matched case-control pairs were identified. Mean case age and BMI was 47.9 years and 31.1 kg/m², respectively, with 46.7% having open fractures. All cases had normal PCT values (<0.50 ng/mL). However, mean erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels were elevated compared to reference values: 58.2 ± 34.4 mm/hr and 5.5 ± 7.3 mg/dL, respectively. Mean PCT levels for cases were 0.067 ± 0.058 ng/mL, while PCT levels for controls were 0.04 ± 0.017 ng/mL; this difference was found to be statistically significant (p = 0.04). Although laboratory threshold for PCT in identifying sepsis is 0.5 ng/mL, our statistical analysis identified the cut-point for FRI at 0.05 ng/mL with specificity and sensitivity for PCT at 83.3% and 46.7%, respectively. Furthermore, when CRP and PCT levels were both below threshold, the specificity for FRI was 96.7%.

CONCLUSION: These preliminary data show that although serum PCT levels do not rise above the reference threshold for sepsis in the presence of FRI, they are significantly elevated compared to matched, uncomplicated control fractures. This suggests that local osteo-articular infections cause a rise in PCT that is not as robust as systemic infections. Combining this new PCT cutoff with CRP testing yields diagnostics with a high specificity for FRI.

Poster 84

Anterior Gluteal Pillar Bone Graft Harvesting using Acetabular Reamer Technique: as effective as Reamer-Irrigator-Aspirator System

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PURPOSE: Gluteal pillar iliac crest (GPIC) harvested with acetabular reamer is a method to obtain autograft from the ilium. The powered reamer efficiently harvests large amounts of graft and preservation of the iliac crest architecture may decrease postoperative pain. The purpose of this study is to evaluate nonunions treated with GPIC harvested with acetabular reamer technique compared to Reamer-Irrigator-Aspirator (RIA). We hypothesized that nonunion treated with GPIC would achieve union rates equivalent to those treated with RIA.

METHODS: Patients who underwent nonunion repair with autograft (2015-2020) were retrospectively reviewed. Injury characteristics, operative data, and radiographs were collected and reviewed until final follow-up. Radiographic union was the defined end point. Complications at both the donor and nonunion site were reviewed and analyzed.

RESULTS: 71 patients met inclusion criteria. GPIC and RIA graft were utilized in 48 and 23 patients, respectively. Average follow-up was 49.5 weeks. The overall union rate was 74.6%, with no difference in union rates between the GPIC and RIA groups (79.2%, 73.9% respectively, $p = 0.21$). No difference was found in time to radiographic union between the GPIC and RIA groups (19.7 weeks, 20.4 weeks respectively, $p = 0.46$). Nine patients in the RIA group required a transfusion, compared to five patients in the GPIC group ($p = 0.004$). Two GPIC patients had persistent harvest site pain that resolved without treatment by six months post operatively. One patient had a superficial infection at the GPIC harvest site, which resolved with oral antibiotics.

CONCLUSION: For the treatment of nonunions, autograft harvested from GPIC via the acetabular reamer technique achieves similar union rates and time to union as RIA. Transfusion rates are higher with RIA, while prolonged harvest site pain is a concern after GPIC. This study is the first to validate equivalent union rates of GPIC compared to RIA for the treatment of nonunion. Further clinical study and potential cost-savings analyses of this technique are warranted.

Poster 85

The Financial Implications of a Hip and Femur Fracture Bundle

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INTRODUCTION: Medicare continues to implement cost-containment initiatives, one of which is the Bundled Care Payment Initiative-Advanced (BCPI-A). The hip and femur bundle for Diagnosis Related Groups (DRG) 480, 481, and 482: Hip and Femur Procedures Except Major Joint includes hip and femur fracture fixation without arthroplasty. This medically comorbid patient population usually undergoes urgent inpatient surgery and cannot be effectively optimized before admission. Concern exists that this bundle is potentially financially unfavorable for hospitals.

METHODS: We retrospectively reviewed a 12-month cohort of 32 consecutive patients in the DRG 480-482 bundle at our academic tertiary referral center. Overall cost, discharge disposition, and readmissions were recorded for all patients in the 90-day bundle.

RESULTS: Overall, a net financial gain averaging \$2,028 per patient with a wide range (-\$52,128 to +\$27,967) was seen. Patients discharged to facilities (n = 19) had significantly higher costs than those who went home (n = 11, P<.001). Use of inpatient rehabilitation (n = 6) averaged a loss of \$10,563 per patient and use of skilled nursing facilities (n = 15) averaged a loss of \$2,457 per patient, compared to a net gain of \$18,347 for patients discharged home (n = 11). Patients who were readmitted (n = 6) were net even (total gain = \$236). The total index admission costs averaged \$12,489 +/- \$2235 per patient (range \$9,329 - \$18,884) and the post-inpatient cost average was \$30,150 per patient (range \$4,803 - \$77,768). Five patients died during the global period.

CONCLUSION: The BPCI-A hip and femur fracture bundle has a wide variability in costs, with the largest proportion in the post-acute care phase. Discharge home is favorable in the bundle while discharge to post-acute facilities leads to net losses. Readmission was not a major factor contributing to financial losses in our program. Institutions in this bundle need to develop multi-disciplinary teams to work at promoting safe discharge to home.

Poster 86

Augmentation of Plate Fixation with Suture Through the Triceps in a Comminuted Olecranon Fracture Model: A Biomechanical and Proof of Concept Study

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INTRODUCTION: Obtaining adequate fixation in olecranon fractures that occur in osteoporotic bone or are especially comminuted or proximal is difficult and typically necessitates locked plate fixation. The deforming force of the triceps on the proximal fracture fragment(s) contributes to failure of fixation. Augmentation of plate fixation with locked stitches placed in the triceps that tie into the plate may prevent loss of fracture reduction and prevent migration of the proximal fragment(s).

METHODS: Matched pairs of cadaver arms are used for testing control (plate only) vs. study (plate with suture augmentation). Specimens underwent standard dissection and locked plate fixation followed by plate removal. A comminution model is then made by removing 1cm of bone from just proximal to the coronoid and confirming standard location relative to the plate on fluoroscopy. For the study specimen, two up down locked (Krackow) sutures are placed with #2 FiberWire along the medial and lateral borders of the triceps and tied into the plate. Specimens are rigidly fixed at the humerus. The elbow is flexed at 90° and the wrist is loaded with a cable and pulley system with variable resistance to extension from 7.5 to 26 N. The triceps is fixed so that the fixation construct is loaded with increasing amounts of deforming force as the elbow is ranged through +/- 45°. The osteotomy gap is measured after each successive increase in load and loading cycles.

RESULTS: Preliminary testing was performed at forces of 7.5, 11, 18.5, and 26 Newtons (N) with 0 and 20 cycles at each and 0, 20, 40, 80, and 160 cycles at the highest load (26N). Osteotomy gapping was measured at each test point. The standard deviation of the osteotomy gap across all measurements was higher in plate fixation alone (0.565) vs. plate fixation with suture augmentation (0.141). The change in final gap from baseline was higher in plate fixation alone (1.75 mm) vs. plate fixation with suture augmentation (0.44 mm). The standard deviation of gaps measured at the 26N point was higher in plate fixation alone (0.408) vs. plate fixation with suture augmentation (0.105).

Further results of five pairs of matched elbow specimens with the use of a servohydraulic load frame (MTS Corp) is in process and will be available at time of presentation (delay is due to COVID related restrictions and closures of the fresh tissue lab).

CONCLUSION: Supplementing locked plate fixation with a locked suture placed along the medial and lateral borders of the triceps and tied into the plate provides substantial stability in a cadaveric fracture model of a comminuted fracture of the proximal olecranon.

Poster 87

Arthroscopic Assisted ORIF vs Open ORIF of Lateral Tibial Plateau Fractures; Does the Publication Record Justify a Large RCT?

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We conducted a systematic review of nine databases to identify all cohort studies documenting the outcomes of arthroscopic assisted ORIF of lateral tibial plateau fractures. 75 studies of which 18 were prospective were identified involving 2,022 patients. 18 of the studies were comparative with patient cohorts of ORIF and arthroscopically-assisted ORIF. The study was registered in the PROSPERO database and we strictly adhered to the PRISMA guidelines for systematic reviews.

RESULTS: Among 53 studies that used categorical functional outcomes, 49 (92%) studies reported excellent/very good or good outcomes in > 80% patients. Sixteen out of 18 studies that used the radiologic outcome Rasmussen score achieved good to excellent results in > 80% of patients. All 18 comparative studies reported similar or slightly better outcomes of arthroscopic-assisted tibial plateau fixation compared to outcomes of the traditional open reduction internal fixation method.

CONCLUSION: Arthroscopic-assisted tibial plateau fixation appears to be an effective method for judging articular reduction and aiding in implant placement. Further clinical trials are needed to compare outcomes and complications following arthroscopic-assisted tibial plateau fixation vs. the traditional open reduction internal fixation without arthroscopy in management of patients with tibial plateau fractures.

LEVEL OF EVIDENCE: Therapeutic Level IV

Poster 88

Use of an Accessory Incision to Reduce Intertrochanteric Fractures of the Femur

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BACKGROUND: Intertrochanteric femur fractures are commonly treated with cephalomedullary nails (CMN). The use of a CMN is often paired with a minimally invasive technique, preventing direct visualization or palpation of the reduction. An accessory incision can be made to permit more direct manipulation of the fragments without direct visualization. There is currently no literature evaluating the effectiveness of this technique. The goal of this study was to evaluate clinical and radiographic outcomes of intertrochanteric fractures treated with cephalomedullary nailing with or without an accessory incision to assist with fracture reduction.

PATIENTS & METHODS: A retrospective review of intertrochanteric femur fractures treated from 9/11/2015-12/30/2018 was completed. 247 patients had complete radiographic and clinical follow-up at 3 months from surgery. The mean age was 79 years, the mean BMI was 26.3 kg/m² with a majority of female patients (67%). Injury, postoperative and three-month follow up radiographs were examined for tip-apex distance, neck shaft angle, lateral screw prominence, fracture collapse, and arthritis. Fracture collapse was calculated by subtracting immediate postoperative lag screw prominence from three-month lag screw prominence. Complications including reoperations and postoperative infection were recorded.

RESULTS: The use of an accessory incision did not have a statistically significant effect on the amount of fracture collapse between those patients treated with an accessory incision and those without (6.6 mm and 5.5 mm respectively, $p = 0.07$). The rate of reoperation was greater in those patients treated with an accessory incision (15% vs. 8%, $p = 0.16$), however, this difference did not reach statistical significance.

CONCLUSION: Fractures that are judged to require more direct manipulation typically demonstrate more displacement than those that can be reduced entirely closed. We demonstrated similar rates of reoperation between those patients that required the use of an accessory incision to reduce the fracture to those that could be reduced entirely closed. Despite increased initial displacement, we found that the use of an accessory incision resulted in similar maintenance of fracture reduction as measured by degree of fracture collapse. We recommend the surgeon have a low threshold to utilize accessory incisions to allow for more direct manipulation of fracture fragments during nailing of intertrochanteric femur fractures.

Poster 89

Does the Diameter of the Intramedullary Nail Affect Post-Surgical Outcomes after Intertrochanteric Femur Fracture? A Retrospective Study

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BACKGROUND: Intertrochanteric femur fractures are commonly treated with cephalomedullary nails (CMN). There is little published data on the effect of the diameter of the nail on clinical and radiographic outcomes. The goal of this study was to compare outcomes of intertrochanteric fractures treated with a CMN based on the diameter of the nail.

PATIENTS & METHODS: A retrospective review of intertrochanteric femur fractures treated from 9/11/2015-12/30/2018 was performed. 247 patients had complete radiographic and clinical follow-up 3 months from the time of surgery. The mean age was 79 years, the mean BMI was 26.3 kg/m² with a majority of female patients (67%). Injury, postoperative and three-month follow up radiographs were examined for tip-apex distance, neck shaft angle, lateral screw prominence, fracture collapse, and arthritis. Fracture collapse was calculated by subtracting immediate postoperative lag screw prominence from three-month lag screw prominence. Complications including reoperations and postoperative infection were recorded.

RESULTS: The diameter of the nail used for fracture fixation did not have a statistically significant effect on amount of overall radiographic fracture collapse ($p = 0.33$) or rate of reoperation ($p = 0.91$).

CONCLUSION: We did not detect a statistically significant difference in clinical or radiographic outcome based on the diameter of the CMN used for treatment of intertrochanteric femur fractures. Prior studies have similarly demonstrated that the nail diameter did not affect the rate of reoperation. We also found that the degree of fracture collapse and thus maintenance of fracture reduction at three months was not affected by the diameter of the nail. A smaller diameter CMN can be utilized for intertrochanteric femur fractures in elderly patients.

Poster 90

Coaptation Splints and Shoulder Immobilizers: Equivocal Outcomes for Diaphyseal Humerus Fractures

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INTRODUCTION: Diaphyseal humerus fracture are traditionally managed with coaptation splinting followed by transition to Sarmiento bracing. The purpose of this study is to compare outcomes of patients alternatively treated acutely with a shoulder immobilizer.

METHODS: We reviewed demographic data, radiographic parameters, and clinical outcomes of patients from 2017-2020 treated for isolated diaphyseal humerus fractures by the two attending coauthors. Radiographic measurements, including fracture shortening, coronal angulation, and anterior angulation, were recorded for all injury radiographs and all radiographs taken at the first clinic visit prior to transition to Sarmiento bracing. The rate of conversion to operative fixation was also analyzed.

RESULTS: Our cohort included 29 patients with an average age of 59 years, average BMI of 32 kg/m², and female predominance (n = 21, 76%). On injury radiographs, the average shortening was 20 mm, coronal angulation was 22°, and anterior angulation was 28°. Radiographic improvements from injury to first follow-up were similar between the shoulder immobilizer and the coaptation splint cohorts. Shortening improved by 3 mm and 10 mm (p = 0.30), respectively. Coronal angulation improved 12° and 9° (p = 0.57). Anterior angulation improved 15° and 12° (p = 0.74). The overall operative rate was 63% (n = 17). Specifically, 67% (n = 14) treated initially with coaptation splinting ultimately proceeded with surgery compared to 50% (n = 3) initially treated with a shoulder immobilizer, this operative rate was statistically similar between the two groups (p = 0.94).

CONCLUSION: There was no significant difference between radiographic outcomes or conversion to operative fixation between patients initially treated with a shoulder immobilizer or a coaptation splint. Based on our results, both forms of initial immobilization are an appropriate bridge to Sarmiento bracing. Interestingly, we had a very high conversion to operative fixation compared to historical literature. Thus, further work should be conducted to re-examine the modern clinical course and outcomes of diaphyseal humerus fractures to further determine which factors may increase the risk of definitive operative management.

Poster 91

Treatment of Recurrent Mobile Spine Chordomas

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INTRODUCTION: There is currently a paucity of data examining outcomes of patients presenting for treatment of a recurrent mobile spine chordoma (C1-L5). The purpose of this study was to review the survival, local recurrence, metastasis, and complications of patients presenting with a recurrent mobile spine chordoma.

METHODS: Over a 24-year period (1995-2019), there were 30 recurrent mobile spine chordomas treated at our institution. There were 26 (87%) males with a mean age of 62 ± 16 years. Tumor location included cervical ($n = 14$, 46%), thoracic ($n = 8$, 27%) and lumbar ($n = 8$, 27%) spine. In patients undergoing surgical resection, the final resection margin was considered positive in 17 (85%) patients. Radiation and/or chemotherapy was used in 20 (67%) patients to assist with treatment. Median follow-up was 6 years (minimum follow-up 2 years).

RESULTS: The mean 2-, 5- and 10-year overall survival was 73%, 39% and 0%. The local recurrence free survival at 2- and 5-years was 38% and 11%. En bloc resection with negative margins had improved local recurrence free survival at 5 years (100% vs. 5%, $p = 0.05$). Positive margins were found to be a risk factor for local recurrence (HR 7.92, CI 1.02-61.49, $p = 0.04$) and operative treatment improved metastatic free survival (HR 0.29, CI 0.08-0.99, $p = 0.05$).

At least one complication was observed in 70% of patients. There was no difference in complications between operative and nonoperative management ($p = 0.13$), however, there was a trend towards increased neurologic decline in patients undergoing nonoperative management ($p = 0.09$). In patients undergoing surgical resection, 11 patients underwent 19 reoperations. The most common indication for reoperation was tumor recurrence ($n = 13$, 69%).

DISCUSSION: A diagnosis of recurrent mobile spine chordoma portends a poor prognosis with an overall survival of less than 40% at 5 years. Complications are common among patients treated with operative or nonoperative management. Surgical resection of a recurrent chordoma may help prevent neurologic decline and tumor metastasis, while en bloc resection with negative surgical margins is associated with improved local recurrence free survival.

Poster 92

Psychiatric Comorbidities in the First Year After Diagnosis of Pediatric Bone or Soft Tissue Sarcomas

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BACKGROUND: Pediatric sarcoma survivors have an increased risk of mood and anxiety disorders as adults. However, to our knowledge, no studies have described the risk of anxiety and depression during the first year after diagnosis. It is also unclear whether patients who suffer from psychiatric comorbidities during the early treatment period are at increased risk of complications. The aim of this study is to describe the risk of anxiety or depression in pediatric sarcoma patients and determine whether psychiatric comorbidities are associated with poor outcomes.

PATIENTS & METHODS: The M30 Orthopedic Dataset from PearlDiver was used to identify pediatric patients with ICD codes for bone or soft tissue sarcomas between 2010-2019. Patients were grouped by the presence or absence of a new anxiety or depression diagnosis within one year of the initial cancer diagnosis. Age, gender, and 90-day readmission rates after initial cancer diagnosis were extracted.

RESULTS: 3,972 patients were identified. 870 (21.9%) developed anxiety or depression within one year of sarcoma diagnosis. Risk was highest in the 15- to 19-year age group (33.6%). Females had a higher risk than males (24.7% vs. 19.6%, $p < 0.0001$). In psychiatric comorbidity group, only 75.4% received treatment. 44.9% received pharmacotherapy alone, 10.3% received psychotherapy alone, and 20.1% received combination therapy. Psychiatric comorbidities were associated with a higher readmission rate (46.7% vs. 18.4% $p < 0.0001$). When the psychiatric comorbidity group was stratified by treatment modality, there was no significant difference in readmission rate with pharmacotherapy alone. However, the addition of psychotherapy resulted in a decrease in 90-day readmission (38.3% vs. 50.6%, $p = 0.0081$).

CONCLUSIONS: One in five pediatric patients will develop anxiety or depression in the first year after sarcoma diagnosis. Fifteen to 19-year-old females are at greatest risk. Psychiatric comorbidities are associated with a 2.5-fold increase in readmission during the first three months of treatment. While pharmacotherapy alone does not mitigate this effect, psychotherapy effectively reduces readmission. Notably, one in four patients are not receiving any treatment for their anxiety or depression. Orthopedic oncologists should regularly screen for anxiety or depression and provide referrals to appropriate psychiatric care. Future research will incorporate PROMIS scores to track anxiety, depression, and oncologic outcomes in our local patient population.

Poster 93

Lack of Radiosensitivity Predicts Poor Oncologic Outcome in Extremity Myxoid Liposarcoma

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BACKGROUND: Myxoid liposarcoma is a common variant of soft-tissue sarcoma which is known to be radiosensitive. Like other types of soft-tissue sarcomas, clinical factors such as tumor depth, high-grade round cell component and depth are known to be associated with oncologic outcome. Although these tumors are known to “shrink” following radiotherapy, there is a paucity of data examining the degree of radiosensitivity in terms of oncologic outcome.

METHODS: We reviewed 65 patients with non-retroperitoneal myxoid liposarcoma undergoing surgical resection combined with preoperative radiotherapy, with pre- and post-radiotherapy MRI. This included 36 (55%) males, with a mean age of 48 ± 14 years at the time of surgery. All tumors were located deep to the fascia, with 14 (22%) having a round-cell component.

RESULTS: There was a reduction in the mean tumor size (15 vs. 12, $p < 0.01$) and volume (1,176 vs. 647, $p < 0.01$) between the pre- and post-radiotherapy MRI, which translated into a volume reduction of $50 \pm 30\%$. Seven (11%) patients having either no change or tumor growth. Lack of radiosensitivity was defined as $\leq 25\%$ volume reduction.

The 10-year disease specific survival was 76%. There was a difference in the 10-year disease specific survival between patients with a radiosensitive tumor and those who had non-radiosensitive tumor (84% vs. 29%, $p < 0.01$). The lack of radiosensitivity translated into a higher risk of death due to disease (HR 4.54, $p < 0.01$), while those with radiosensitive tumors had a lower risk of death due to disease (HR 0.21, $p < 0.01$).

Local recurrence occurred in 5 patients (8%) at a mean 3 years (range 1-5 years) postoperative. The 10-year local recurrence free survival was 89%. No analyzed factor was associated with local recurrence.

Metastatic disease occurred in 21 (32%) patients at a mean 2 years. The 10- year metastatic disease-free survival was 62%. Patients with non-radiosensitive tumors were at increased risk of metastatic disease (HR 3.47, 95% CI 1.46-8.28, $p < 0.01$), while those with radiosensitive tumors were at reduced risk for metastatic disease (HR 0.28, 95% CI 0.12-0.68, $p < 0.01$).

CONCLUSION: Myxoid liposarcoma is a common variant of liposarcoma that is known to be radiosensitive when compared to other types of soft-tissue sarcoma. The radiosensitivity of this tumor has translated into improved patient outcome, however, the results of the current series highlights that not all myxoid liposarcomas are radiosensitive and those that do not respond to radiotherapy are higher risk for metastatic disease and subsequent death due to disease.

Poster 94

Presence of a Soft-Tissue Mass is Associated with Worse Outcome for Patients with Scapular Chondrosarcoma

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BACKGROUND: Chondrosarcomas are common primary bone tumor in adults, often affecting the flat bones. The scapula is a common location for these tumors, however, there is a relative lack of outcome studies, with previous series having conflicting results.

METHODS: Thirty-nine patients (26 males:13 females) with a mean age of 46 ± 17 undergoing surgical resection of a scapular chondrosarcomas were reviewed. Most patients had Grade I ($n = 24$) tumors, with 26 (67%) having an associated soft-tissue mass. The mean follow-up was eight years. Reconstruction of the scapula was based on the resection.

RESULTS: The 10-year disease specific survival was 77%. High grade tumors ($HR\ 18.15, p < 0.01$) were associated with death due to disease. The 10-year local recurrence- and metastatic- free survival were 77% and 74%. Positive surgical margins ($HR\ 8.85, p < 0.01$) was associated with local recurrence and local recurrence was associated with metastatic disease ($HR\ 3.37, p = 0.04$). All disease recurrences and death due to disease occurred in patients with a soft-tissue mass ($p < 0.05$).

Following surgery, the mean MSTS93 rating was $77 \pm 19\%$ and the mean shoulder elevation was $81 \pm 66^\circ$. When examining the patient function based on the type of resection patients who underwent had a partial scapulectomy which preserved the glenoid had improved outcome in terms of mean MSTS93 ($p < 0.01$) and mean forward elevation of the shoulder ($p < 0.01$).

CONCLUSION: Presence of a soft-tissue mass was associated with a worse oncologic outcome in patients with scapular chondrosarcomas. Positive margins were associated with local recurrence, which was associated with metastatic disease; as such wide local excision with negative margins should be goal for all patients, regardless of tumor Grade.

Poster 95

Characterizing the MPNST Patient Population in Texas and Identifying Poor Prognostic Indicators

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BACKGROUND: Malignant peripheral nerve sheath tumors (MPNST) carry a poor prognosis due to frequent recurrence and widespread metastasis. Neurofibromatosis Type 1 (NF-1) patients carry a greater risk of acquiring MPNST at a young age. Currently, there are no standardized screening protocols for NF-1 patients due to uncertainty surrounding risk factors for malignant transformation. The aim of this project is to describe the incidence and characteristics of MPNST patients in Texas and identify poor prognostic indicators.

PATIENTS & METHODS: De-identified patient data was retrieved from the Texas Cancer Registry® (TCR). Patients with a histologic diagnosis of MPNST between 1995 and 2018 were identified. Seventy-three patients who died of other or unknown causes were excluded. Demographics, clinical presentation, tumor characteristics, and survival outcomes were extracted.

RESULTS: 443 patients were identified. The cumulative incidence of MPNST in Texas between 2000 and 2018 was 2.5 per 100,000 individuals. Hotspots are in Hamilton, Garza, Jim Hogg, San Saba, Winkler, and Goliad counties. Compared to the overall Texas population, there is a larger proportion of African American patients in our cohort (20.5% vs. 12.9%) and a smaller proportion of Hispanic patients (29.8% vs. 39.7%). One third of the cohort lives in a high-poverty area. The median tumor size at diagnosis was 78 mm (IQR 42.5 – 122 mm) and median survival was 39 months (IQR 12.5 – 126 months). The disease specific mortality rate was 49.7%. A weak negative correlation between tumor size and survival was seen ($r = -0.24$) however there was no correlation between age at diagnosis and survival ($r = 0.03$).

CONCLUSION: In Texas, black patients and patients in high-poverty areas are at greater risk of developing MPNST. This data also demonstrates the high mortality of MPNST, emphasizing the importance of creating adequate screening protocols and improving treatment regimens. While a weak correlation between tumor size and survival was identified, it is notable that tumor size was missing for 125 patients in the TCR database, so the analysis was limited. Future research will be directed towards a local chart review that expands on this analysis and attempts to identify factors associated with early malignant transformation and poor prognosis.

Poster 96

Vertebral Body Height Changes During Treatment of Scheuermann's Kyphosis

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PURPOSE: This study investigates the changes in thoracic vertebral height as patients with Scheuermann's kyphosis underwent treatment with a Risser cast or brace. Previous literature shows the Cobb measurement can improve with casting, but no study has evaluated the changes in vertebral body height at the apex of the deformity as a result of treatment.

METHODS: A retrospective review of our IRB-approved, prospectively-collected pediatric spinal deformity database was performed, evaluating patients treated for Scheuermann's kyphosis with Risser casting and bracing between 1992-2019. Of 18 casting patients, only 6 patients were treated with both Risser casting and bracing and also had adequate imaging. Radiographs for these patients were measured beginning before their first cast and throughout their care. The three most apical vertebra were measured for each patient. The height of the vertebral body at the anterior and posterior wall was measured and considered as a ratio, as well as compared across time.

RESULTS: The apical vertebrae were T6-T9 on all patients. The mean ratios of anterior to posterior heights for T6-T9 prior to casting were 0.78, 0.80, 0.74, and 0.79, respectively. The mean ratios of anterior to posterior heights for T6-T9 after casting were 0.84, 0.80, 0.81, and 0.82, respectively. The mean ratios of anterior to posterior heights for T6-T9 after bracing were 0.77, 0.74, 0.75, and 0.87, respectively. Percent change of vertebral height ratios for T6-T9 from prior to casting and last available radiograph were 6.75% increase, 1.03% decrease, 7.92% increase, and 8.53% increase, respectively. Percent change of vertebral height ratios for T6-T9 from before casting to last cast were 7.26% increase, 3.75% decrease, 9.32% increase, and 3.47% increase, respectively. Percent change of vertebral height ratios for T6-T9 during bracing were 0.74% decrease, 3.23% decrease, 4.10% decrease, and 8.43% increase, respectively.

DISCUSSION: For T6, T8, and T9, there was an overall positive change in the ratio of anterior to posterior vertebral heights from the beginning of treatment to completion. Improvement was also noted during Risser casting. The T6, T7, and T8 vertebrae, however, showed a negative change in the ratio from the end of Risser casting to the end of treatment. Bracing has well known limitations, and in this case is not as effective as Risser casting for restoring and improving the vertebral body height that is affected in Scheuermann's kyphosis.

Poster 97

Tarsal Coalition: Surgical Long-Term Outcomes

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INTRODUCTION: Tarsal coalition has been known as a common pediatric problem. Few large cohort studies exist analyzing complication rate during long-term follow-up in those that have received operative treatment. Our study aims to analyze risk factors for complications and long-term outcomes of surgical resection of coalitions.

METHODS: After IRB approval, patients under 18 years of age who underwent excision of tarsal coalition at a single academic center from 2010-2019 were identified. Medical records were reviewed for collecting variables such as basic demographics, surgical technique, coalition characteristics, postoperative complications, and coalition recurrence. Patients were then asked to complete a PROMIS Physical Function and Pain Interference in addition to the Foot Function Index. A total of 44 patients (54 cases total) were included in the final analysis with 17 patients (22 cases) completing patients reported outcomes.

RESULTS: The median age at surgery was 12 years (IQR 3). 35 cases (64.8%) were from male patients, while 19 cases (35.2%) were from female patients. Pain was the predominant symptom in 49 (90.7%) of cases. Pes planovalgus was present in 25 cases (46.3%). 40 cases (74.1%) had calcaneonavicular coalition compared to 12 cases (22.2%) with talocalcaneal coalition and two cases (3.7%) with both. Fibrous coalition was found in 19 cases (35.2%) and the most common. Interposition material was used in 49/54 (90.7%) cases. Wound complications or temporary neuropraxias were seen in 7/54 cases (13.0%), and coalition recurrence occurred in 3/54 cases (5.6%). At a median of six years (IQR 6.0) postoperatively, the median postoperative outcomes scores were as follows: PROMIS Physical Function 54.7 (IQR 17.9), PROMIS Pain Interference 38.7 (IQR 10.0), FFI Pain 14.0 (IQR 30.0), FFI Disability 1.0 (IQR 9.0), FFI Activity Limitation 3.0 (8.0), and FFI Total 6.0 (12.0).

CONCLUSION: At long-term follow-up, pediatric patients who underwent excision of tarsal coalition had higher physical function and less pain than the U.S. population at large (PROMIS score of 50 is population average).

Poster 98

Concussion Rates in Lacrosse: An Analysis of the Pediatric Population

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INTRODUCTION: Sport-related concussions are estimated to occur up to 3.8 million times per year in the United States. Despite the popularity of youth sports in the US, there has been little focus on concussions in youth lacrosse. The purpose of this study was to provide a descriptive analysis of the epidemiology and incidence of concussions in youth lacrosse. For relative incidence rates, we will compare our results to well-documented analyses of concussions in American football.

METHODS: The National Electronic Injury Surveillance System was used to collect data on concussion injuries occurring during lacrosse in pediatric patients from 2006-2019. Nationwide estimation of injury incidence was determined using weighted calculations and combined participation data obtained from the U.S. Lacrosse membership records. A comparison dataset was collected for football using the NEISS data on football related concussions. Type of lacrosse contact was categorized into player-to-player, player-to-stick, player-to-ball, and player-to-ground. Incidence was compared over each year, by age and gender.

RESULTS: The database yielded an estimate of 1,302 concussions related to lacrosse over the study period, of which 67.6% occurred in males. National participation in lacrosse steadily increased from 2006 to 2012 by an average of 10.27% annually and then experienced a lower annual growth rate of 2.53% from 2012 to 2019. There was a statistically significant increase in incidence of concussions for girls and boys from 2006 to 2012 which then declined for the duration of the study period. An increase in incidence of concussions was also seen in football players through 2012, but then marginally declined from 2012 to 2019. The average concussion incident rate for youth lacrosse was 23.29% per 100,000 participants which was significantly higher than the incident rate for football (7.19% per 100,000 participants).

CONCLUSION: Lacrosse, which quickly gained popularity among young American athletes, has experienced a lower annual rate of growth in participation over recent years. As participation rates increased from 2006 to 2012, the relative rates of concussions in both genders rose as well. However, since 2012, the rate of concussions has declined which may be attributed to the declining rate of growth in the sport and rule changes in lacrosse which varied by gender. While the incidence of concussion in lacrosse is declining, it remains at a much higher rate per participant than what is observed in football. Future studies should focus on education and increased prevention efforts for concussions in lacrosse given the higher incidence than youth football.

Poster 99

Preliminary Results of a Unilateral, Peri-Apical Distraction Device (ApiFix) for Fusionless Treatment in Adolescent Idiopathic Scoliosis

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INTRODUCTION: Adolescent idiopathic scoliosis (AIS) curves necessitating surgical intervention are traditionally addressed with posterior spinal fusion with instrumentation. The ApiFix system presents a potentially less invasive surgical option. Designed as an internal brace, the system consists of an expandable rod and ratcheting extender attached with 3 screws. Indications to implement the ApiFix device are strict. Eligible patients must have a single, flexible Lenke 1 or 5 curve (i.e. reduces to less than or equal to 30° on side-bending). The patients' Cobb angle must be between 35-60° with thoracic kyphosis less than 55° from T5 to T12. The primary purpose of this study is to report preliminary outcomes of patients undergoing ApiFix implantation.

METHODS: IRB approval was obtained for this longitudinal, prospective cohort study. Patients presenting with AIS meeting inclusion criteria for ApiFix were consented for enrollment. Preoperative radiographs and scoliometer measurements recorded curve magnitude and flexibility as well as trunk asymmetry, respectively. These values were again recorded immediately postoperatively. All patients were enrolled in a standardized physical therapy program. Patients are being followed for additional measurements at 6-months and 1- year postoperatively. Preliminary results are reported.

RESULTS: The present analysis included 26 patients with AIS treated with ApiFix, 20 having reached 6-month follow-up and 8 reached 1-year. Lenke 1 and 5 curves represented 18 and 8 patients, respectively. Length of stay for all patients was 1 night. Lenke 1 patients had average intraoperative blood loss of 23 mL and 91-minute length of surgery. Average initial curve magnitude was 47° and average immediate postoperative curve was 21°. At 6-month follow-up, the average curve magnitude for Lenke 1 patients was 22° and 18° at 1 year. Lenke 5 patients had average estimated intraoperative blood loss of 27 mL and length of surgery of 101 minutes. Their average initial curve magnitude was 47° with an average immediate postoperative curve magnitude of 21°. The average curve magnitude for Lenke 5 patients was 20° and 17° at 6-months and 1-year, respectively.

DISCUSSION & CONCLUSION: Preliminary results show that ApiFix implantation plus physical therapy decreases AIS curve magnitude postoperatively. All patients studied at 6-month follow-up had regained preoperative flexibility. Initial results show ApiFix may be a viable less invasive treatment option for AIS, however long-term follow-up is needed. Ongoing analysis of 6-month and 1-year follow-up data as they are collected will provide further insight.

Poster 101

Scapholunate Ligament 360 Procedure: A Preliminary Outcomes Report

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PURPOSE: The purpose was to evaluate early clinical, patient-reported, and radiographic outcomes of the scapholunate ligament 3600 tenodesis (SL 360) technique for treatment of scapholunate (SL) instability.

METHODS: Nine patients who underwent the SL 360 procedure for reducible SL instability were identified. Final follow-up was a mean of 33.5 months (12-51.3 months). Clinical, radiographic, and patient reported outcome data including Mayo Wrist Score (MWS), and Patient Rated Wrist Examination (PRWE) were collected. Means were analyzed using 2-tail, paired t-test with $p < 0.05$ as the value used for determining significance.

RESULTS: Before surgery, patients with SL instability were significantly impaired with respect to wrist extension and grip strength (extension, 46 vs. 66°; grip strength 25 vs. 50 kg) compared to the unaffected side. The SL gap (4.9 vs. 2.1 mm) and SL angle (66 vs. 50°) were also significantly greater in the affected wrist. At final follow-up, there was improvement regarding clinical, radiographic, and functional outcomes comparing preoperative to final postoperative values, respectively [VAS (7 vs. 1), MWS (44 vs. 80), PRWE (58 vs. 12) and QuickDASH (54 vs. 12), SL gap (5.1 vs. 2.8 mm), and SL angle (66 vs. 58°)].

CONCLUSION: The SL 360 procedure for reducible SL instability has favorable early clinical, patient-reported, and radiographic outcomes. The suture tape and tendon construct confers robust stability permitting earlier mobilization without the inherent disadvantages of K wire stabilization.

Poster 102

Is DRUJ arthritis a problem after total wrist arthrodesis? A single-institution case series

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INTRODUCTION: Concomitant radiocarpal (RC) and distal radioulnar joint (DRUJ) arthritis can be debilitating for patients and the approach to surgical management of these combined arthritides can be challenging for surgeons. The purpose of this study was to examine patients with radiographic evidence of both radiocarpal and DRUJ arthritis preoperatively who underwent total wrist arthrodesis alone, to determine the need for reoperation to address their DRUJ arthritis.

MATERIALS & METHODS: A retrospective chart review was performed for all patients who underwent primary total wrist arthrodesis (TWA) from 2008-2018 at a single institution. A total of 183 patients underwent TWA during the study period. Only patients with radiographic evidence of DRUJ arthritis preoperatively were included. Patients who underwent TWA for inflammatory arthritis, infection, previous failed total wrist arthrodesis, or with less than one-year follow-up were excluded, as well as any patient who underwent a procedure involving the distal ulna or DRUJ prior to or at the time of TWA. Primary outcome measure was subsequent surgical management of symptomatic DRUJ arthritis.

RESULTS: A total of 31 patients who underwent isolated TWA for RC arthritis with concomitant DRUJ arthritis were included in this study. Mean follow-up was 5.3 years (range 18-152 months). Seven patients developed symptomatic DRUJ arthritis after TWA (23%), of which 4 underwent a surgical procedure for the DRUJ arthritis (12.9%) which was performed at an average of 20 months postoperatively (range 3-60 months). Additionally, two patients received a corticosteroid injection alone into their DRUJ for pain relief after initial TWA.

CONCLUSION: A small subset of patients (13%) who presented with radiographic evidence of both radiocarpal and DRUJ arthritis required a secondary surgery to treat their symptomatic DRUJ arthritis after initial TWA. As such, treating the RC arthritis in isolation is a reasonable initial approach despite the presence of concomitant DRUJ arthritis. However, patients should be counseled preoperatively that subsequent surgical management of progressive symptomatic DRUJ arthritis may be necessary.

Poster 104

Revenue Generation and Follow-up for a Hand Trauma Program in an Inner City Metropolitan Area

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HYPOTHESIS: Though hand trauma care has been shown to be profitable for hospitals, loss of trauma patients may lead to revenue lost. The goal of our study was to: (1) elucidate the economic impact of a hand trauma program, (2) quantify the potential fiscal impact of loss of follow-up, and (3) determine the patient factors that contributed to leakage of these patients within the healthcare system.

METHODS: Revenue data was retrospectively extracted for all adult hand trauma patients within a multi-center midwest healthcare system from 2014-2018. Other variables analyzed included demographics, new or established patient status, admission to hospital or intensive care unit, and insurance type. After these variables were identified, a Wilcoxon rank sum test was utilized to test for differences in continuous variables, a Pearson's Chi-squared test was used for categorical variables, and an odds ratio was calculated for each variable. A follow-up model was created using logistic regression. Results with a p-value <0.05 were considered statistically significant.

RESULTS: 56,995 (31% new patients, 69% established) hand trauma encounters were recorded. The likelihood of patient follow-up increased with age (OR 1.02 per year of age; $p < 0.001$). Patients that were new to the health system had a lower follow-up rate (OR 0.5, $p < 0.001$) compared to established patients. Hospital admission (OR 1.92, $P < 0.001$) was associated with higher follow-up rates. Hand surgery consultation, type of insurance, race, and ethnicity all contributed significantly to follow-up rates ($p < 0.001$). Of the 17,748 new patients presenting due to hand trauma, 27% of them returned for follow-up within 6 weeks. 8,638 new patients returned for subsequent care within 2 years, generating a total of \$34M of revenue. The new and established patients that did not return for care may have lost \$176M for the system.

SUMMARY: Several factors contribute to significant loss of follow-up after emergent hand trauma presentation including age, race, ethnicity, new patient status, insurance status, ICU and hospital admission, and lack of hand surgery consultation. Understanding these factors can help target efforts to minimize leakage of hand trauma patients and improve continuity of care. Hand trauma is a robust avenue to introduce new patients to a system and generate significant revenue. Consequently, leakage of hand trauma patients can have significant revenue losses and disruption of care.

Poster 105

Paraspinal Sarcopenia Predicts Worse Patient Reported Outcomes Following Posterior Cervical Fusion

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STUDY DESIGN: Retrospective cohort study.

OBJECTIVES: Studies in the lumbar spine suggest a correlation between sarcopenia and worse patient outcomes. The purpose of this study was to determine whether paraspinal fat degeneration as described by Goutalier grade is associated with radiographic and patient-reported outcomes in patients undergoing posterior cervical fusion (PCF).

METHODS: We performed a retrospective cohort study of patients undergoing PCF at a single institution between the years 2015 and 2020. We utilized preoperative magnetic resonance images to classify patients into Goutalier grades. Radiographic parameters including bone mineral density (BMD), longus colli and multifidus size, and cervical deformity measurements including but not limited to C2 SVA, C2 slope, C2-C7 lordosis and thoracic kyphosis were obtained. Patient-reported outcomes, including Neck Disability Index (NDI), RAND score, and EQ-5D scores and surgical complications were recorded. These parameters were analyzed according to the patients' Goutalier grade.

RESULTS: We identified 99 patients for inclusion. A total of 36 patients were classified as Goutalier 0-1 (group 1), 39 were Goutalier 2 (group 2), and 24 were Goutalier 3-4 (group 3). Goutalier groups 1 and 2 experienced significant improvement in all 3 outcome scores. Goutalier group 3 did not experience a significant improvement in NDI. Average postoperative NDI scores were 12.7 in group 1, 14.3 in group 2, and 21.6 in group 3. The percentage of patients in each group reporting worse disability after surgery was 0% in Group 1, 17.9% in Group 2, and 41.6% in Group 3 ($p < .01$)

CONCLUSIONS: The present study is the first to assess the association between cervical paraspinal muscle Goutalier grade and patient-reported outcomes following PCF. Based on our study, patients with worse cervical paraspinal degeneration preoperatively were less likely to experience improvement after surgery.

Poster 106

Decreased Hounsfield Units Predict Cervical Interbody Subsidence

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INTRODUCTION: While several patient and technique-related risk factors for subsidence have been proposed, the relationship between low bone mineral density (BMD) and interbody subsidence remains unproven. The primary purpose of this study was to utilize computed tomography to characterize subsidence of cage interbodies in ACDF and determine the influence of BMD on pseudarthrosis. The secondary aim of this study was to evaluate whether preoperative Hounsfield Unit (HU) measurements are predictive of increased risk of severe subsidence in the cervical spine.

METHODS: We performed a retrospective review of a prospective cohort of patients undergoing 1 to 3 level ACDF and anterior plating at a single institution between the years of 2011-2020. Bone mineral density was characterized according to the WHO classification. Hounsfield Units were measured on preoperative CT scans in the cancellous bone of the operative levels on three separate axial slices. Graft subsidence was assessed on CT scan performed at least six months postoperatively and characterized according to the level, location, and severity of subsidence. We classified subsidence as mild if <2 mm, moderate if 2-4 mm, and severe if >4 mm. Patients were then divided into two groups: (1) normal BMD and (2) low BMD, which included both osteopenic and osteoporotic patients. Student's t-test was used to compare all means between groups.

RESULTS: We identified 52 patients (97 levels) for inclusion. On sagittal CT for the entire cohort, the mean superior endplate subsidence was 1.37 mm+/-1.14 and the mean inferior endplate subsidence was 1.84 mm+/-1.40. Comparison of subsidence based on bone mineral density demonstrated significantly increased superior (1.95 vs. 1.08 mm, p = 0.002), inferior (2.51 vs. 1.50 mm, p = 0.001), and cumulative (4.46 vs. 2.58 mm, p<0.0001) subsidence on sagittal CT images. Univariate analysis comparing patients with normal and decreased BMD demonstrated a significant difference in BMI (30.5 vs. 24.5, p<0.001), average hip t-score (0.29 vs. -1.79, p<0.0001), average spine t-score (1.36 vs. -1.41, p<0.0001), and HU at every axial cut of both the superior- and inferior-most operative levels. Patients with low BMD demonstrated a higher rate of pseudarthrosis than those with normal BMD (38.9 vs. 14.7%), but this did not reach the level of statistical significance (p = 0.08).

CONCLUSIONS: Patients with decreased BMD experience nearly two times more subsidence than patients with normal BMD. Furthermore, Hounsfield Units are a useful surrogate for a DEXA scan to identify patients with low BMD who may benefit from additional preoperative optimization.

Poster 107

Leave it Alone: The Natural History of Growth Friendly Graduates Without a Final Fusion

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INTRODUCTION: The natural history of growth-friendly graduates treated with growing instrumentation but no final fusion is unknown. Two small reports, including 30 patients who had traditional growing rods (TGR) and 12 patients treated with vertical expandable prosthetic titanium rib (VEPTR) exist, but there is no comprehensive data set in the literature.

METHODS: The Pediatric Spine Study Group database was queried for patients treated with TGR or VEPTR who had at least two years of follow-up. Patients met inclusion criteria if they had not undergone a final fusion procedure, but had completed planned interventions for early onset scoliosis. Demographic data included age, gender, race, etiology, diagnosis, comorbidities, height, weight, ambulatory status, and prior treatment. Radiographic data included major/minor cobb angles, spinal height, sagittal kyphosis, and proximal junctional degree.

RESULTS: There were 1,215 patients who underwent growth-friendly surgery TGR or VEPTR with no documented final fusion, and 234 of those had minimum 2 years follow-up. Diagnoses were heterogeneous (99 congenital, 71 neuromuscular, 43 syndromic, 20 idiopathic, and 1 other/not-specified). Definitive treatment strategy was implant maintenance in 204 (87%) and removal in 30 (13%). Of those who did not keep their implants, 18/30 (60%) had an UPROR sometime prior to implant removal and 1/30 (3%) had an UPROR which was implant removal. Of the patients who retained their implants, the UPROR rate prior to definitive procedure was 30% (62/204). In that group, 9/204 (4%) had an UPROR following their definitive procedure. The proportion of patients who successfully avoided an UPROR after definitive procedure was similar between those who retained compared to removed implants. Patients whose implants were removed lost a mean 7 degrees of curvature compared to 3 degrees in those who implants were retained. The means of all other measurements, including minor cobb angle, spinal height, and kyphosis were similar between the two groups.

CONCLUSIONS: Growth-friendly graduates who are observed but do not undergo a final fusion have a high UPROR rate overall, but only 4% after their definitive procedure. The curve magnitude has been well maintained in this cohort whether implants were removed or kept.

Poster 108

Mask-Wearing Practices During COVID-19 Do Not Influence Preoperative *S. aureus* Colonization Rates in Patients Receiving Elective Orthopedic Surgery

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INTRODUCTION: Patients with positive preoperative nasal swabs for *Staphylococcus aureus* (MRSA and MSSA) are at increased risk for surgical site infection (SSI). Decolonization of the nares preoperatively appears to reduce this risk. Because *S. aureus* colonizes the nares and can spread via respiratory droplets, we hypothesized that *S. aureus* colonization might decrease as a function of mask-wearing requirements. Here we compared preoperative *S. aureus* positivity rates before and after issuance of a state-wide COVID-19 mask mandate in a cohort of 4,317 orthopedic patients.

METHODS: Electronic medical records (EMR) for all elective total joint and orthopedic spine cases performed at our institution between January 2019 through April 2021 (N = 5,102) were reviewed for the presence of preoperative *S. aureus* screening. Patients with preoperative *S. aureus* screening results (N = 4,317) were split into two patient groups, a pre-mandate cohort (N = 2,811: January 1, 2019-July 31, 2020) and a post-mandate cohort (N = 1,506: August 1, 2020-April 30, 2021). *S. aureus* positivity rates were then compared across the two groups using SPSS statistical software.

RESULTS: Results revealed no significant differences in *S. aureus* positivity rates between the pre- and post-mandate cohorts for MRSA (pre-mandate: 0.7%; post-mandate: 1.1%; $t = -1.4$, $df = 4,315$, $p = 0.16$) and MSSA (pre-mandate: 16.3%; post-mandate: 15.3%; $t < 1$, $df = 4,315$, $p = 0.4$). Importantly, these results did not differ even when adjusted to account for the potential early adoption of mask-wearing practices by some patients at the onset of the COVID-19 pandemic (i.e., March 2020-July 2020; MRSA) and prior to implementation of formal mask-wearing mandates ($p = 0.64$; MSSA: $p = 0.36$).

DISCUSSION: Collectively, the findings reported here represent a paradox when considered in the context of prior work examining SSI rates during the COVID-19 pandemic. Specifically, Losurdo and colleagues (2020) report reduced SSI rates and reasonably speculated that mask-wearing practices may serve as an early preventative measure to reduce postoperative SSI rates. Indeed, this rationale motivated the current research. However, results from this larger cohort demonstrate that preoperative rates of *S. aureus* colonization did not change as a function of mask-wearing practices during COVID-19 - a finding that suggests alternative mechanisms (e.g., hospital social distancing practices, increased exercise, and improved self-health practices) may account for the reduction in SSIs observed during the COVID-19 pandemic.

Poster 109

Predictive Analysis of the Health Resource Utilization after Elective Spine Surgery

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INTRODUCTION: The management of degenerative spine pathology continues to be a significant source of costs to the healthcare system in the United States. In addition to surgery, utilization of healthcare resources after spine surgery drives cost. The responsibility of managing costs is gradually shifting to patients and providers. Patient-centered predictors of healthcare utilization after elective spine surgery may identify targets for cost reduction and value creation. The purpose of this study is to quantify patterns of healthcare utilization and identify risk factors that predict high healthcare utilization after elective spine surgery.

METHODS: 623 patients who underwent elective spine surgery at a tertiary academic medical center by one of three fellowship-trained orthopedic spine surgeons between 2013 and 2018 were identified. Healthcare utilization was quantified including advanced spine imaging, emergency and urgent care visits, hospital readmission, reoperation, PT/OT referrals, opioid prescriptions, epidural steroid injections, and pain management referrals, among others. Patient variables, namely the Charlson comorbidity index (CCI) and the American Society of Anesthesiologists (ASA) classification system, were assessed as potential predictors for healthcare utilization. Univariate logistic regression was used to identify potential risk factors for high healthcare use after surgery.

RESULTS: Among all patients, a wide range of baseline demographics and healthcare utilization were identified. 90-day postoperative complications are listed in. The univariate analysis, controlling for age and BMI, demonstrated that both CCI and ASA scores were predictive of various markers of higher healthcare utilization in the 365 days following surgery including: emergency department visits, spine imaging studies, opioid and nerve blocker prescriptions, inpatient rehabilitation, any referrals, and pain management referrals.

CONCLUSIONS: Markers of patient health – such as CCI and ASA class – may be used to predict healthcare utilization following elective spine surgery. Identifying at-risk patients and addressing these challenges prior to surgery is an important step to deliver efficient postoperative care.

Poster 111

Ankle Joint Weightbearing CT Three-Dimensional Distance Maps of Progressive Collapsing Foot Deformity: A Retrospective Case-Control Study

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INTRODUCTION: Progressive Collapsing Foot Deformity (PCFD) is traditionally assessed with two-dimensional radiography, which can be inaccurate due to the complex three-dimensional configuration of the deformity. Instead, the structural alterations in ankle joint alignment may be optimally characterized through weightbearing computed tomography (WBCT). This study aimed to use 3D distance maps (3DDMs) to objectively characterize the effects of PCFD on the tibiotalar joint.

METHODS: With IRB-approval, 20 PCFD and 10 control patients who underwent WBCT were evaluated retrospectively. 3DDMs were generated from WBCT data across the tibiotalar interface. Each DM consisted of thousands of individual measurements across the talar dome, which was divided into a 3-by-3 grid to evaluate each region's coverage and distances.

RESULTS: In PCFD patients, talar dome coverage was lower in the anteromedial (52.9%, $p < 0.003$), anterior middle (32.0%, $p < 0.02$), and anterolateral (29.4%, $p < 0.02$) regions and higher in the posteromedial (42.5%, $p < 0.009$), posterior middle (56.3%, $p < 0.00002$), and posterolateral (84.0%, $p < 0.0003$) regions. The anteromedial (40.3%, $p < 0.0006$) and anterolateral (42.6%, $p < 0.002$) gutter coverage was significantly decreased, while the posteromedial (3.1%, $p = 0.34$) and posterolateral (5.5%, $p = 0.41$) gutter regions had non-significant decreases. The mean distances in the anteromedial (1.70 mm), anterior middle (1.52 mm), anterolateral (1.30 mm), posteromedial (2.04 mm), posterior middle (2.02 mm), and posterolateral (2.35 mm) regions in controls were not significantly lower than in PCFD patients.

CONCLUSION: Our 3DDM findings revealed significant differences in the position of the talus in patients with PCFD compared to controls. Decreases in the anteromedial, anterior middle, and anterolateral dome coverage with increases in the posteromedial, posterior middle, and posterolateral talar dome coverage is consistent with increased plantar flexion and anterior translation of the talus relative to the tibia in PCFD patients. However, none of the patients studied had indications of severe tibiotalar arthritis, found in later stages of PCFD progression, as shown by the mean talar distances. 3DDMs from WBCT may provide early indication of previously underappreciated tibiotalar joint changes. Therefore, this novel 3DDM method can be utilized to quantify the impact of hindfoot valgus on the ankle joint in PCFD patients and may help identify or predict late complications like ankle arthritis.

Poster 112

Impact of Resilience on Patient-Reported Outcomes of First Metatarsophalangeal Arthrodesis

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INTRODUCTION: Resilience is an interactive dynamic construct most simply defined as the ability to recover from stress. To date, there is no literature examining the impact of resilience on the outcomes following foot and ankle surgery.

METHODS: We retrospectively reviewed patients who underwent first MTP arthrodesis from September 2011 to May 2020, 98 met inclusion criteria. Medical records were reviewed for patient characteristics and union status. PROMIS Physical Function (PF), Pain interference (PI), Depression (D), and the Foot Function index (FFI) were collected. Resilience was measured using the Brief Resilience Scale. A multivariable linear regression analysis examining the impact of resilience on patient-reported outcomes while adjusting for potential confounding covariates was conducted.

RESULTS: At an average of 3.4 ± 2.6 (SD) years postoperatively, resilience was found to have an independent effect on patient-reported outcomes across all instruments, except the FFI pain subscale. Resilience's effect on the instruments was as follows: PROMIS physical function (Unstandardized β 5.0, 95% CI 2.6 to 7.4), PROMIS pain interference (Unstandardized β -4.8, 95% CI -7.8 to -1.8), PROMIS Depression (Unstandardized β -9.4, (95% CI -12.8 to -6.1), FFI disability subscale (Unstandardized beta -13.3, 95% CI -20.3 to -6.3), FFI activity limitation subscale (Unstandardized beta -15.7, 95% CI -23.0 to -8.5), FFI total (Unstandardized beta -11.7, 95% CI -18.1 to -5.4), and FFI pain subscale (Unstandardized beta -6.5, 95% CI -13.1 to .01).

CONCLUSIONS: In this first study examining the impact of resilience following foot and ankle surgery, we found that resilience has an independent positive effect on overall physical function, disability, pain, and mental health following MTP arthrodesis. Preoperative resilience scores could be used to predict postoperative functional outcomes following MTP arthrodesis and guide postoperative rehabilitation. These findings help establish the role of early positive psychosocial characteristics within the orthopedic foot and ankle population.

Poster 113

Utilization of Arthroscopy During Ankle Fracture Fixation among Early Career Surgeons: An Evaluation of the American Board of Orthopaedic Surgery Part II Oral Examination Database

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INTRODUCTION: Rotational ankle fractures are common injuries associated with high rates of intra-articular injury. Traditional ankle fracture open reduction and internal fixation (ORIF) techniques provide limited capacity for evaluation of intra-articular pathology. Ankle arthroscopy represents a minimally invasive technique to directly visualize the articular cartilage and syndesmosis while aiding with reduction and allowing joint debridement, loose body removal, and treatment of chondral injuries. The purpose of this study was to evaluate temporal trends in concomitant ankle arthroscopy during ankle fracture ORIF surgery amongst early-career orthopedic surgeons while examining the influence of subspecialty fellowship training on utilization.

METHODS: The American Board of Orthopedic Surgery (ABOS) Part II Oral Examination database was queried to identify all candidates performing at least one ankle fracture ORIF from examination years 2010 to 2019. All ORIF cases were examined to identify those that carried a concomitant Current Procedural Terminology (CPT) code for ankle arthroscopy. Concomitant ankle arthroscopy cases were categorized by candidates self-reported fellowship training status and examination year. Descriptive statistics were performed to report relevant data and linear regression analyses were utilized to assess temporal trends. Statistical significance was defined as $p < 0.05$.

RESULTS: During the study period, there were 36,113 cases of ankle fracture ORIF performed of which 388 cases (1.1%) were performed with concomitant ankle arthroscopy. Ankle fracture ORIF was most frequently performed by trauma fellowship-trained ABOS Part II Oral Examination candidates ($n = 8,888$; 24.6%), followed by sports medicine ($n = 7,493$; 20.8%), and foot and ankle ($n = 6,563$; 18.2%). Arthroscopy was most frequently utilized by foot and ankle fellowship-trained surgeon (n /cases, 4.5%) followed by sports medicine (n /cases, 0.4%), and trauma (n /cases, 0.1%) with respect to arthroscopic cases, 293 cases (75.5%) were performed by foot and ankle fellowship trained surgeons, 29 (7.5%) sports medicine, and 4 (1.0%) trauma. Ankle arthroscopy utilization significantly increased from 3.65 cases per 1,000 ankle fractures in 2010 to 13.91 cases per 1,000 ankle fractures in 2019 ($p = 0.010$). Specifically, foot and ankle fellowship-trained surgeons demonstrated a significant increase in arthroscopy utilization during ankle fracture ORIF over time ($p < 0.001$; OR: 1.101; CI: 1.054-1.151).

CONCLUSION: Ankle arthroscopy utilization during ankle fracture ORIF has increased over the past decade. Foot and ankle fellowship-trained surgeons contribute most significantly to this trend.

Poster 114

Are Preoperative PROMIS Scores Associated With Postoperative ED Visits?

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INTRODUCTION: Preoperative Patient-Reported Outcomes Measurement Information System (PROMIS) scores have been shown to be predictive of postoperative success in orthopedic foot and ankle patients. The purpose of this study was to determine if an association exists between preoperative PROMIS scores and visits to the emergency department (ED) in the first 60 days following their operation.

METHODS: PROMIS scores, including physical function (PF) and pain interference (PI), were collected from 290 patients prior to foot and ankle procedures. Patients with presence of ongoing infection were excluded. Electronic medical record data was retrospectively gathered for each patient to determine if visited the ED for any reason during the first 60 days following their operation. A Backward Stepwise Logistic Regression analysis was conducted for postoperative ED visits with $p < .1$ in univariate analysis required for entry in the model.

RESULTS: The median age was 50.0 with an interquartile range (IQR) of 20.0. The median BMI was 33.1 with an IQR of 11.6. In univariate analysis, patients who visited the ED within 60 days had lower preoperative PROMIS PF (median 34.9 & IQR 10.2) and higher PROMIS PI (median 66.9 & IQR 9.1) compared to patients who did not visit the ED (PROMIS PF median 38.0 & IQR 10.2 and PROMIS PI 63.6 & IQR 9.0, respectively). In multivariate analysis, only PROMIS PF was associated with lower risk of ED visits OR .92 (95% CI .85-.99). Other factors independently associated with ED visits included non-traumatic surgical indication OR 3.7 (95% CI 1.1-12.9), any pulmonary disease OR 4.2 (95% CI 1.4-12.8), ASA classification OR 4.4 (95% CI 1.3-14.9), and wound complications OR 10.2 (95% CI 2.6-39.9).

CONCLUSION: Patients with lower PROMIS PF scores preoperatively were significantly more likely to visit the ED postoperatively. While all of the factors found to be associated with ED visits are not modifiable by the surgeon, preoperative PROMIS scores could quickly and easily be used to identify patients for potential interventions. This study demonstrates the potential of the PROMIS outcomes system outside of quantifying surgical outcomes. Further study is being conducted to investigate the optimal PROMIS PF cutoff for best identifying patients at risk for ED visits.

Poster 115

Radiographic Indirect Parameters for Rotation do not Correspond to Real Measurements in Hallux Valgus

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BACKGROUND: Subjective radiographic findings are commonly used in Hallux Valgus (HV) to dictate deformity aspects and surgical treatment. Head roundness, distal metatarsal metaphyseal angle (DMMA), and sesamoid positioning are used as predictors of ray pronation, intrinsic deformities, and soft tissue imbalance despite lack of reliability. Estimation of first metatarsal rotation based on different head shapes has been proposed, including for severity classification. This study evaluates whether first metatarsal rotation measured by alpha angle in weightbearing computed tomography (WBCT) correlates with head shape.

METHODS: In this study, we analyzed 26 hallux valgus feet (19 patients) and 20 control feet (16 patients) using radiographs (XR) and WBCT. Head format, roundness classification (0, 1, 2, or 3), head plantar surface diameter, hallux valgus angle (HVA), intermetatarsal angle (IMA), DMMA, sesamoid station, rotation, arthritis, and metatarsal rotation (alpha angle) were evaluated. Interclass correlations coefficients (ICC) were calculated for interrater reliability. Normative data were analyzed by ANOVA and comparison among groups and methods by Student's t-test. A multivariate regression was used to evaluate which measurements influenced rotation classification and a partition prediction model was constructed to assess which variables contributed to the grading system. Statistical significance was considered for $p < 0.05$.

RESULTS: All ICCs were above 0.80 for both XR and WBCT. HV patients and controls were analogous regarding age and body mass index. Similarity was found in WBCT and XR for traditional HV angles, considering both groups. Mean values were higher in HV patients than controls for alpha angle (11.51 [9.42-13.60] to 4.23 [1.84-6.62], 95%CI), head diameter (22.35 [21.52-23.18] to 21.01 [20.07-21.96]) and sesamoid rotation angle (26.72 [24.09-29.34] to 4.56 [1.63-7.50]). HVA and IMA were poorly correlated to alpha angle (values < 0.11). WBCT assessment downgraded head roundness classification in comparison to XR. Changes in classification were explained chiefly by sesamoid station in the axial plane ($R^2: 0.37$), where stations 4-7 were strong predictors of roundness classification 2 and 3. Alpha angle had low influence in head roundness classification ($R^2: 0.15$).

CONCLUSION: Head roundness does not reliably predict metatarsal rotation. Glenos sesamoid arthritis and sesamoid subluxation alter first metatarsal head format and diameter, blurring roundness evaluation. Sesamoid stations 4-7 were strong predictors of higher roundness classifications. Measurements using different readers and methods (XR and WBCT) were reliable. Alpha angle did not influence head roundness classification nor correlated to HV severity.

Poster 116

Does Distal Metatarsal Articular Angle reflect a real joint deformity in Hallux Valgus? A case control study

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INTRODUCTION: The Distal Metatarsal Articular Angle (DMAA) has long been described as a valgus increase of the distal articular surface of the first metatarsal in Hallux Valgus (HV) deformity. Since then, several studies have reported a poor reliability of this measurement. Some authors currently claim that DMAA is misinterpreted as just the rounded shape of the lateral part of the first metatarsal head reflecting pronation of the first ray which could also be biased by the first metatarsal plantarflexion angle.

Our study aimed to compare the DMAA in HV and control populations after correcting, using dedicated software, pronation, and plantarflexion of the first metatarsal.

METHODS: We performed a retrospective case-control study including 36 HV and 20 control feet. Patients under 15 or with prior surgery were excluded.

DMAA1 was measured as initially described on x-rays by the angle between the distal articular surface and the longitudinal axis of the first metatarsal. DMAA2 was measured on Weightbearing Computed Tomography (WBCT) without any corrections. DMAA3 was measured after digital correction of the first metatarsal plantarflexion in the sagittal plane. DMAA4 was measured after correction of the pronation of the first ray relative to the ground in the coronal plane using the alpha-angle and DMAA5 after both corrections.

Normality was assessed using Shapiro-Wilk tests. Comparisons were made using Student tests for normal variables and Mann-Whitney for non-normals.

RESULTS: HV and Control groups were comparable on BMI ($p = 0.69$), Age ($p = 0.58$) and Gender ($p = 0.27$).

DMAA1 ($25.9^\circ \pm 7.3$ vs. $7.6^\circ \pm 4.2$; $p < 0.01$), DMAA2 ($19.1^\circ \pm 7.1$ vs. $3.3^\circ \pm 2.4$; $p < 0.01$), DMAA3 ($16.1^\circ \pm 6.2$ vs. $2.9^\circ \pm 2.4$; $p < 0.01$), DMAA4 ($14.4^\circ \pm 5.7$ vs. $2.6^\circ \pm 2.5$; $p < 0.01$) and DMAA5 ($11.9^\circ \pm 4.9$ vs. $3.3^\circ \pm 2.9$; $p < 0.01$) were significantly higher in the HV group than in the Control group.

Significant decreases in angles were present between DMAA1 and DMAA2 ($\Delta = -6.9$; CI95%[-8.6;-5.1]; $p < 0.01$), DMAA2 and DMAA3 ($\Delta = -3$; CI95%[-4.1;-1.9]; $p < 0.01$), DMAA2 and DMAA4 ($\Delta = -4.7$; CI95%[-6.3;-3.1]; $p < 0.01$), DMAA2 and DMAA5 ($\Delta = -7.2$; CI95%[-8.8;-5.6]; $p < 0.01$) and between DMAA3 and DMAA4 ($\Delta = -1.7$; CI95%[-2.9;-0.5]; $p < 0.01$) in the HV group.

CONCLUSIONS: Although overestimated with the 2-dimensional DMAA assessment, the valgus increase of the distal articular surface of the first metatarsal was present in the HV deformity, even after correction of pronation and plantarflexion of the first ray. DMAA overestimation was close to 14 degrees on x-rays and 7 degrees on WBCT without any correction.

Poster 117

Coronal Plane Deformity Correction In End Stage Ankle Osteoarthritis Using A Lateral Trans-fibular Approach Total

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INTRODUCTION: Ankle osteoarthritis (AO) is often due to prior trauma and presents with joint deformity. Total ankle replacement (TAR) has been advocated as the best procedure to reduce pain and maintain joint flexibility, but a lateral trans-fibular approach has not been fully tested on its ability to correct foot and ankle alignment. Weightbearing computed tomography (WBCT) allows for the measurement of foot and ankle offset (FAO), talar tilt angle (TTA), and hindfoot moment arm (HMA), while the joint supports weight, to accurately judge the joint alignment in the coronal plane pre- and post-operation. Our hypothesis was that a lateral trans-fibular approach TAR will allow significant improvement in coronal plane deformities in end-stage ankle osteoarthritis patients.

METHODS: This retrospective cohort study with IRB approval, included 15 patients that underwent lateral approach TAR for AO. Patients received pre- and postoperative WBCT imaging on the affected ankle. Using multiplanar reconstruction of WBCT images, 3D landmark coordinates (on X, Y, and Z planes) were manually found, and an automatic calculation of FAO was given as a percentage. TTA and HMA were found using dedicated software on the same coronal plane WBCT images.

RESULTS: The average and 95% CI postoperative improvement for respective FAO, TTA, and HMA: (4.45%; 2.92-5.98%), (7.0 mm; 3.20-10.80 mm), and (4.92 mm; (2.65-7.19%). Significant difference was observed when comparing pre- and postoperative TTA (7.81 mm vs. 1.36 mm, $p = 0.0018$). A trend toward significance was also observed pre- and postoperative for FAO and HMA, respectively, (7.36% vs. 4.46%, $p = 0.1753$) and (10.47 mm vs. 6.85 mm, $p = 0.2801$).

CONCLUSIONS: The Lateral approach TAR showed ability to improve coronal plane deformity and foot and ankle alignment in secondary AO. TTA was found to be significantly reduced by 7 mm postoperative, while FAO was decreased by 4.45%, and HMA by 4.92 mm. Further studies are needed to compare lateral approach TARs ability to correct alignment with other procedures.

Poster 118

The Impact of Surgical Timing after Ankle Fracture on Clinical and Long-Term Patient-Reported Outcomes

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INTRODUCTION: Advances in surgical technique and technology have allowed orthopedic surgeons to attempt early operative fixation of closed ankle fractures. Little is known about the modifiable factors impacting the recovery of these patients and how early operative intervention affects patient reported outcomes. This study aims to determine if early surgical treatment can be performed safely without increasing a patient's risk for postoperative wound complications and how time to surgery affects both clinical and long-term patient reported outcomes.

METHODS: A retrospective analysis of 215 patient records, after exclusions, who underwent open reduction and internal fixation (ORIF) for an ankle fracture from July 2011 to July 2018 was conducted. A total of 86 patients completed PROMIS outcomes scores at long-term follow-up. Primary outcomes were the rate of delayed union, postoperative wound complications, Patient Reported Outcome Measurement information System (PROMIS) Pain interference (PI), and Physical Function (PF) scores.

RESULTS: No differences were found when comparing time to surgery on a continuous scale with rates of delayed union, nonunion, or wound complications ($p = 0.84, 0.47, \text{ and } 0.63$, respectively). PROMIS scores were collected at a median of 4.5 years (2.0 interquartile range (IQR), Range 2.5 to 12.3) postoperatively. The time from ankle fracture to surgery was independently associated with worse PROMIS PI scores (Unstandardized β .38, 95% CI .07 to 0.68), but not PROMIS PF scores. Severe Lauge-Hansen injuries were independently associated with decreased PROMIS PF scores (Unstandardized β -7.02, 95% CI - 12.0 to -2.04).

CONCLUSIONS: Increased time to surgical intervention and severe Lauge Hansen injuries were independently associated with worse long-term patient-reported outcomes. Surgical timing did not impact union rates or wound complications. Surgeons should be aware that delaying ankle fracture repair beyond 12 days after injury may negatively affect long-term patient reported pain scores.

Poster 119

Prevalence And Risk Factors Of Postoperative Falls Following Foot And Ankle Surgery

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INTRODUCTION: Postoperative falls following orthopedic surgery have potentially devastating consequences for patients and place immense burden on the healthcare system. No study to date has examined the incidence of or risk factors for postoperative falls following foot and ankle surgery. We aimed to investigate the incidence and risk factors for postoperative falls in foot and ankle surgery using a mixed inpatient and outpatient population that is reflective of modern practice.

METHODS: A single fellowship-trained foot and ankle surgeon instituted routine collection of a postoperative fall questionnaire at two- and six-weeks postoperatively. A retrospective review of 135 patients with complete prospectively collected fall questionnaire data was performed. Medical records were reviewed for patient demographic information, injury characteristics, comorbidities, baseline medications, length of hospital stay, visual analogue scale (VAS) pain scores from preoperative and 2-week appointments, and complications. These characteristics were compared between patients who did and did not fall in the first six weeks after surgery. After univariable analysis, a multivariable binary logistic regression was conducted to assess independent risk factors for postoperative falls.

RESULTS: The median (interquartile range) age was 52 (21) with a BMI of 32.7 (11.1). One-hundred and eight patients (80%) underwent outpatient procedures. A total of 39 out of the 135 patients (28.9%) reported experiencing a fall in the first six weeks after surgery. In multivariable analysis, Antidepressant use (adjusted odds ratio 3.41 (95% CI 1.19 – 9.81) and the VAS pain score at two weeks postoperatively (adjusted odds ratio 1.27 (95% CI 1.08 -1.50) were found to be independent risk factors for postoperative falls.

CONCLUSIONS: This study adds to the growing evidence of a high postoperative fall incidence within orthopedic surgery after hospital discharge. Baseline antidepressant use and two-week VAS pain scores were associated with postoperative falls and could be used to target potential interventions. Orthopedic surgeons need to develop more holistic treatment algorithms to mitigate the effects of antidepressant use and perceived pain on postoperative outcomes, including fall risk.

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Amendola, Annunziato	1, 3a, 3b – Arthrex, Inc.; 3b – Bioventus, CONMED Linvatec, Lima Corporation; 3c – Extremity Development Corporation, Rubber City Bracing; 3c, 4 – Bone Solutions Inc., CRES Inc., Miach Orthopaedics; 4 – Bio2 Technologies; 5 – Stryker; 7 – Springer, Wolters Kluwer Health – Lippincott Williams & Wilkins
Ames, Elizabeth	n
Ames, Tyler D.	n
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An, Qiang	n
Anderson, Donald D.	4 – Iowa Simulation Solutions, LLC
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Anderson, John T.	n
Anderson, Michael R.	n
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Andrews, Nicholas A.	n
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Austin, Daniel C.	n
Austin, Matthew S.	1, 5 – Zimmer; 2, 3b – DePuy, a Johnson & Johnson Company; 2, 3b, 4 – Corin USA; 3b – Link Orthopaedics; 7 - JayPee
Awad, Mohamed E.	n
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Baboolal, Thomas G.	6 - Nuvasive
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Badman, Brian L.	3b – DJ Orthopaedics; 4 – CTM Biomedical, Paragen Technologies; 5 – Arthrex, Inc.
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Baker, Courtney E.	n
Baker, Kevin	5 – Arthrex, Inc., Stryker, Synthes, Zimmer
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Balk, John	n
Ballard, Matthew	n
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Bartels, Douglas W.	n
Barton, R. Shane	n
Barton, Richard S.	n
Baskar, Deepika	n
Basques, Bryce A.	7 - Thieme
Bazzi, Talal	n
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Berger, Jeffrey S.	4 - PrinterPrezz
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Bobko, Aimee	n
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Bramer, Michelle	3c - Zimmer
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Brennan, Jacob L.	n
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Bridges, Chauncey	n
Brogan, David M.	5 – Checkpoint Surgical, DePuy, a Johnson & Johnson Company, Neuraptive Therapeutics; 7 - Springer
Brolin, Tyler J.	3b, 5 – Arthrex, Inc.; 5 – DJ Orthopaedics, Orthofix, Inc.; 7 - Elsevier
Brooks, William	n
Brown, Nicholas M.	6 – DePuy, a Johnson & Johnson Company
Brown, Shimron	n
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Fowler, John R.	5 – Avadim, Inc.; 7 – Springer, Thieme
Fox, James D.	n
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Go, Beatrice C.	n
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Greif, Charlotte S.	n
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Grunhut, Joel	n
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Hanson, Danielle	n
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Harrelson, Whitt	n
Harris, Jeremy	n
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Heil, Sally D.	n
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Hirschfield, Adam G.	n
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Holderread, Brendan	n
Hollinsworth, Troy D.	n
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Hooke, Alexander	n
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Huffman, Cuyler	n
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Hughes, Mitchell J.	n
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Jacob, Roshan	n
Jacobs, Joshua J.	3b – Smith & Nephew; 3b, 5 – Zimmer; 4 – Hyalex; 5 – Medtronic Sofamor Danek, Nuvasive
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Jassim, Sayfe A.	n
Jenkins, Skyler	n
Jennewine, Brenton	n
Jensen, Hannah	n
Jiang, Charles	n
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Johnson, Joshua E.	n
Johnson, Michael D.	3b – in2bones, ODI; 5 – SBI
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Kadakia, Anish R.	1 – Acumed, LLC, Biomedical Enterprises, DePuy, a Johnson & Johnson Company; 2, 3b, 5 – Arthrex, Inc.; 7 – Elsevier, Lippincott Williams & Wilkins
Kadouh, Ali	n
Kaeding, Christopher C	2, 3b – Arthrex, Inc.; 5 – Vericel, Zimmer
Kakar, Sanjeev	3b – Arthrex, Inc.; 4 – Sonex Healthcare
Kamineneni, Srinath	n
Karam, Matthew D.	4 – Iowa Simulation Solutions LLC
Karas, Vasili	3b, 4, 5 – Corin U.S.A.; 3b, 5 - Stryker
Karim, S. Mohammed	n
Karim, Saleema	n
Karlstad, Ava G.	n
Karlstad, Ryan R.	n
Karns, Michael R.	n
Kaufman, Matthew W.	n
Kautz, Steven M.	4 – SKMB, LLC
Kaye, I. David	3b – Johnson & Johnson; 3b, 5 – Camber Spine; 7 - Thieme
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Keith, Jerrod N.	n
Kelley, Todd C.	3b, 5 – DePuy, a Johnson & Johnson Company
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Kelly, Robert	n
Kemper, W. Craig	n
Kepler, Christopher	1 – Inion; 5 – Regeneration Technologies, Inc.
Kerzner, Benjamin	n
Kesler, Kyle	n
Kessler, Adam	n
Khalil, Lafi S.	n
Khan, Safdar N.	2 – Johnson & Johnson; 3b – Bioventus, Prosidyan, Spinal Elements
Khazi, Zain M.	n
Khlopas, Anton	n
Khoury, Laila	n
Kian, Shayar	n
Kiehl, Daniel	n
Kim, H. Mike	n
Kinchelow, Daria	n
Kindsfater, Kirk A.	1, 2, 3b, 5 – DePuy, a Johnson & Johnson Company; 3b - Stryker
Kiner, Dirk W.	3b – Globus Medical
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Klapach, Aimee S.	n
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Klika, Alison K.	n
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Knudsen, Michael L.	n
Koh, Jason	2 – Smith & Nephew; 3a, 4 – Marrow Access Technologies; 4 - Acuitive
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Kollmorgen, Robert C.	n
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Kolowich, Patricia A.	n
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Kolz, Joshua M.	n
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Koolmees, Dylan S.	n
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Koso, Riikka E.	n
Krauss, Zachary J.	n
Krebs, J. Collin	n
Krebs, Viktor E.	n
Kreulen, Timothy	n
Krishnan, Pranav	n
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Kruckeberg, Bradley M.	n
Krueger, Chad A.	3b – Smith & Nephew
Krych, Aaron J.	1, 3b, 5 – Arthrex, Inc; 3b – JRF Ortho, Vericel; 5 – Aesculap/B.Braun, Arthritis Foundation, Ceterix, Histogenics
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Kumar, Jayanth	n
Kunze, Kyle N.	n
Kupfer, Noam	n
Kurcz, Brian P.	n
Kurian, Shyam J.	n
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Lall, Ajay C.	3b – Graymont Medical; 3b, 5, 6 – Arthrex, Inc.; 5, 6 – Stryker; 6 – Iroko, Midwest Associates, Smith & Nephew, Vericel, Zimmer Biomet

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Larson, Dirk R.	n
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Laughlin, Mitzi S.	n
Lavin, Alessia C.	n
Lavoie-Gagne, Ophelie	n
Lawrenz, Joshua M.	n
Layson, James T.	n
Le, Theodore T.	n
Leary, Steven M.	n
Lee, Dustin R.	n
Lee, Eugenia	n
Lee, Hee Young	n
Lee, Michael S.	n
Lehl, Caleb J. A.	n
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Lesko, James	3a – DePuy, a Johnson & Johnson Company; 4 – Johnson & Johnson
Levine, Ari D.	n
Levine, Brett R.	3b – Exactech, Inc., Link Orthopaedics, Merete; 5 – Zimmer
Levy, Bruce A.	1, 3b – Arthrex, Inc; 3b – Smith & Nephew; 4 – COVR Medical LLC
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Lewis, Brian D.	3b – Stryker, Zimmer
Lewis, Jennifer B.	n
Li, Shuyuan	n
Liberman, Shari R.	n
Linderman, Shannon E.	3a – Figur8 Inc.
Lindsay-Rivera, Kevin	n
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Littlefield, Zachary L.	n
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Liu, Raymond W.	1 – Orthopediatrics (royalties paid to my university); 7 – Journal of Pediatric Orthopedics
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Mahoney, Craig R.	5 – Smith & Nephew
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Makhni, Eric C.	2 – Xodus Medical; 3b – Smith & Nephew; 7 - Springer
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Mallett, Katherine E.	n
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Nassr, Ahmad	5 – AO Spine, Pfizer, Premia Spine
Natoli, Roman M.	5 – Novasteo; 6 – MicroGen Dx; 7 – Morgan & Claypool
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Neviaser, Andrew S.	3b – CONMED Linvatec, Exactech, Inc.
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Niemann, Michael	n
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Noiseux, Nicolas O.	1 – Link Orthopaedics; 5 – DePuy, a Johnson & Johnson Company, MicroPort, Smith & Nephew
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Palumbo, Reid A.	n
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Pannu, Tejbir S.	n
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Pappademos, Paul C.	n
Pareek, Ayoosh	3b - Moximed
Park, Kwan J.	3b – Smith & Nephew
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Parkulo, Travis	n
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Pate, James	n
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Patel, Kishan	3a - Pfizer
Patel, Milap S.	n
Patel, Preetesh D.	3b – Stryker, Zimmer
Patetta, Michael J.	n
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Pinter, Zachariah W.	n
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Platt, Brooks N.	n
Plummer, Darren	n
Podeszwa, David	3c – Orthofix, Inc., Orthopediatrics; 7 - Elsevier
Poe-Kochert, Connie	n
Polce, Evan M.	n
Politi, Joel R.	1, 2, 3b – DePuy, a Johnson & Johnson Company
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Ponce, Brent A.	1, 2, 3b – Stryker; 3b – Orthopedic Designs North America Inc., Smith & Nephew; 4 – Help Lightning
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Porter, Scott	n
Potter, G. David	n
Pourzal, Robin	6 - Zimmer
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Prayson, Michael J.	5 – Smith & Nephew
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Quan, Theodore	n
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Raji, Yazdan	n
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Ramazanian, Taghi	n
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Ramiz, Amani I.	n
Ramo, Brandon	7 – Saunders/Mosby-Elsevier
Ramski, David	n

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Reedy, Isabel	n
Reilly, Mark C.	2 - Stryker
Reinholz, Anna K.	n
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Ren, Weiping	n
Rexroth, John D.	n
Rhee, Peter C.	2, 3b – Trimed
Riccio, Anthony I.	2 – OrthoPedicatrics; 5 – Arthrex, Inc.; 7 – Saunders/Mosby-Elsevier
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Riepen, Dietrich W.	n
Riesgo, Aldo M.	3b – Stryker, Zimmer
Riley, Patrick M., Jr.	n
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Rizzo, Marco	n
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Roche, Martin W.	1, 2, 3b, 5 - Stryker; 5 – Smith & Nephew
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Rodriguez, Joel A.	n
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Rose, Peter S.	n
Rose, Ryan A.	n
Ross, Phillip R.	n
Rossi, David	n
Roumeliotis, Anastasios G.	n
Routman, Howard D.	1, 2, 3b, 5 – Exactech, Inc.; 2 – Smith & Nephew
Rouzrokh, Pouria	n
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Ryskamp, David	n
Ryssman, Daniel B.	n
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Sabesan, Vani J.	3b – Zimmer; 5 – Lifenet, Orthofix, Inc., Wright Medical Technology, Inc.
Sabetian, Payam W.	n
Safdar, Nasia	n
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Saks, Benjamin R.	n
Salata, Michael J.	3b – Stryker
Salazar, Dane H.	3b – Tornier, Zimmer
Salazar, Luis M.	n
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Salmons, Harold I.	n
Sampognaro, Gabriel G.	n
Samson, Kaeli K.	n
Sanchez, Peter H.	n
Sanchez-Sotelo, Joaquin	1, 2, 5 – Stryker; 3b – Acumed, LLC, Exactech, Inc.; 4 – Precision OS, PSI; 7 – Elsevier, Journal of Shoulder and Elbow Surgery, Oxford University Press
Sanders, Eric J.	n
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Sarvari, Fahad	n
Savoie, Felix H., III	1 – Zimmer; 1, 3c – CONMED Linvatec, Exactech, Inc.; 3c – Biomet, Mitek, Smith & Nephew
Sawatzke, Alexander B.	n
Sawyer, Jeffrey R.	2, 5 – DePuy, a Johnson & Johnson Company; 3b – Orthopediatrics; 7 – Elsevier
Sawyer, Kathryn	n
Sayan, Ardalan	n
Schaffer, Jonathan L.	3b – Lyfstone AS; 3b, 4 – Compliant Innovations, LLC, MyDoc PTE LTD; 4 – iBalance Medical; 7 – Elsevier, Springer, Taylor and Francis
Schaver, Andrew L.	n
Scheidt, Michael D.	n
Scherl, Susan A.	7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Schickendantz, Mark	3b – Arthrex, Inc.; 4 – Infinite Arthroscopy Inc., Limited
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Schmidt, Gregory J.	n
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Schultz, Kathryn E.	n
Schumaier, Adam P.	n
Schwartz, Herbert S.	6 – Musculoskeletal Transplant Foundation
Schwarzkopf, Ran	1, 3b, 5 – Smith & Nephew; 3b, 4 – Intelijoint; 4 – Gauss Surgical, PSI
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Seetharam, Abhijit	n
Segreti, John C.	4 - Pfizer
Seidel, Henry	n
Seidenstein, Alexandra	n
Seiffert, Kayla	n
Sekeramayi, Tinotenda	n
Seligson, David	3b – Stryker; 5 – Pacira Pharma; 7 - Springer
Sems, S. Andrew	1, 3b - Zimmer
Serbin, Philip A.	n
Serino, Joseph	n
Sethi, Neal	n
Shaffer, Lynn	n
Shah, Ashish B.	n
Shah, Chirag	n
Shah, Nihar S.	n
Shamrock, Alan G.	n
Sharma, Ishani	n
Shaw, Jonathan H.	n
Shea, Kevin G.	3c, 4 – nView, Inc., Sarcio, Inc.; 5 – Ossur, Vericel
Shearer, Jennifer L.	n
Shelfbine, Lara	n
Sherman, Alain E.	n
Sheth, Bhavya	n
Shi, Lewis L.	2 – Arthrex, Inc.; 2, 3b - DePuy, a Johnson & Johnson Company
Shihab, Yazen A.	n
Shin, Alexander Y.	1 – Mayo Medical Ventures, Trimed
Shinar, Andrew A.	1, 3b – Smith & Nephew
Siebler, Justin C.	n
Siegel, Eric R.	n
Sierra, Rafael J.	1 – Orthalign; 1, 3b – Link Orthopaedics; 1, 5 – Zimmer; 2, 3b, 5 – Biomet; 3b – Think Surgical, Inc.; 5 – Cytori, DePuy, a Johnson & Johnson Company, Stryker; 7 – Springer
Silverton, Craig D.	1 - Biomet
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Sirkin, Michael S.	1, 3b – Osteocentric, S.E.A.L.; 7 – Saunders/Mosby-Elsevier
Sivasundaram, Lakshmanan	n
Siyaji, Zakariah K.	n
Skalitzky, Mary K.	n
Skelley, Nathan W.	n
Smartt, Anne A.	n
Smith, Austin F.	n
Smith, Haley E.	n
Smith, Hugh M.	n
Smith, John T.	1, 3b –Globus Medical; 2 – Missonix; 3b – Biomet, DePuy, a Johnson & Johnson Company, GS Medical,Nuvasive, Wishbone Medical
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Smith, Matthew J.	1, 2 – DePuy, a Johnson & Johnson Company; 1, 4 – Ignite Orthopedics; 5 – Arthrex, Inc., Wright Medical Technology, Inc.
Smith, Nolan S.	n
Smith, Patrick A.	1, 2, 3b, 5 – Arthrex, Inc.; 4 – Spinal Simplicity
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Solitto, Giovanni F.	n
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Soriano, David F.	n
Sowers, Mackenzie	n
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Sperling, John W.	1 – Innomed, Responsive Arthroscopy; 1, 3b – Zimmer; 3b, 4 – RA
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Sponseller, Paul	1 –Globus Medical; 1, 3b, 5 – DePuy, a Johnson & Johnson Company; 6 – Orthopediatrics; 7 – Journal of Bone and Joint Surgery - American
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Stuart, Michael B.	n
Stuart, Michael J.	1, 3b, 5 – Arthrex, Inc; 5 – Stryker
Su, Charles A.	n
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Swiontkowski, Marc F.	7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Synder, Marek	n
Szatkowski, Jan P.	3b – Acumed, LLC, Stryker
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Tanenbaum, Joseph E.	n
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Turner, Norman S.	n
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Vivtcharenko, Victoria	n
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Watson, David	2, 3b – Corin USA, Smith & Nephew
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Wilson, Philip L.	5 – AlloSource, Ossur; 7 – Elsevier
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