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

MAOA FIRST PLENARY SESSION
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1. A Randomized Clinical Trial of Minimally Invasive TKA: Comprehensive Gait and Strength Testing Outcomes

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(Presented by Robert T. Trousdale, M.D., Rochester, MN)

INTRODUCTION: Minimally invasive techniques for TKA have often been accompanied by substantial changes in perioperative pain management, rapid rehabilitation protocols, and patient education initiatives that made it difficult to determine if these new surgical techniques truly add benefit. This randomized clinical trial used objective comprehensive gait analysis and strength testing data to determine if MIS TKA improved functional outcome compared to a standard medial approach in a contemporary surgical practice with advanced pain management, rehabilitation, and patient education protocols.

METHODS: Forty patients were randomized to the mini-subvastus or standard approach using a computerized process administered by our Biostatistics group. One experienced surgeon with an interest in MIS TKA did all procedures. Patient and evaluator were blinded, and the groups were dynamically balanced based on age, sex, and BMI. Peak isometric knee flexion and extension strength was measured and comprehensive gait analysis was done during walking and stair climbing preoperatively and then postoperatively at two months and at two years.

RESULTS: No difference in the Knee Society Score, quadriceps strength, or gait parameters was observed between the mini-subvastus approach and the standard medial parapatellar approach, except a higher speed during stair ascent two months after surgery in the MIS group ($p=0.018$). As expected after TKA, in both groups, improvements in Knee Society Score were dramatic ($p<0.0001$ for each subscale) as were improvements in gait parameters, particularly in knee kinematic and kinetics, during level walking and stairs ($p<0.0001$ to 0.045). Quadriceps strength increased two months after surgery in the MIS and MPP groups ($p=0.038$ and 0.022, respectively) although remaining lower when compared to the sound limb ($p=0.007$ and 0.002, respectively).

CONCLUSION: In our high-volume practice with advanced pain management, rapid rehabilitation, and patient education protocols in place, we could find no substantial additive benefit of a minimally invasive TKA over a standard TKA.

2. Patient Specific Instrumentation in Total Knee Arthroplasty Provides No Improvement in Component Alignment

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INTRODUCTION: Improved implant positioning and alignment in total knee arthroplasty (TKA) remains a commonly cited benefit of patient-specific instrumentation (PSI), but has not yet been thoroughly evaluated. We hypothesized that PSI would lead to improved accuracy in component alignment when compared to traditional instrumentation (TI) during primary TKA.

METHODS: Sixty-five knees in 59 prospectively enrolled patients who underwent TKA with the use of PSI were compared to a cohort of 62 consecutive patients who had previously undergone TKA with TI. Anteroposterior (AP), lateral, and AP long-standing postoperative radiographs were evaluated for mechanical axis, femoral notching, and coronal and sagittal alignment of the femoral and tibial components. Goal alignment was within +/- 2° of planned femoral flexion of 3°, posterior tibial slope of 3°, mechanical axis of 0°, femoral valgus of 5°, and tibial varus of 0°.

RESULTS: There was no difference with respect to age, gender, BMI, or operative blood loss between the two groups. The implanted femoral, tibial, and polyethylene insert sizes were also similar. There was no statistically significant difference in component alignment including femoral flexion, femoral valgus angle, tibial varus angle, and overall alignment between the two groups. PSI demonstrated greater mean posterior tibial slope (6.3° PSI vs. 5.1° TI, p=0.017) and decreased accuracy with only 36% of PSI knees implanted within the target range of posterior slope compared to 61% within the target range with TI (p=0.004).

CONCLUSION: We found no improvement in component alignment with decreased accuracy in tibial slope with the use of PSI compared to TI during primary TKA. We cannot currently recommend the use of this technology due to no appreciable alignment benefit with an associated additional cost and resource utilization.

SUMMARY: Patient specific instrumentation resulted in no improvement in implant alignment with decreased accuracy of the tibial component posterior slope in comparison to traditional knee arthroplasty.

3. CAS vs. Manual TKA: No Difference in Clinical or Radiographic Outcomes at 5-Year Follow-Up

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INTRODUCTION: The use of computer-assisted surgery (CAS) offers the experienced surgeon the ability to improve limb and implant alignment and reduce outliers. A previous case-controlled study by this author demonstrated no significant difference in clinical, functional, or radiographic outcomes between CAS and manual TKA at short-term follow-up. The purpose of the present study was to determine whether any differences in clinical, functional, or radiographic outcomes could be elicited between patients who underwent either CAS or manual TKA at five-year follow-up.

METHODS: Forty manual and 38 CAS TKA were performed by a single surgeon. The groups were identical with regard to age, sex, body mass index, diagnosis, surgical technique, implants, and perioperative management. Sixty-one patients were available for five-year follow-up. Pre- and postoperative radiographic measurements of the mechanical axis was assessed. The Knee Society scoring system and UCLA activity score was used to assess clinical and functional outcomes.

RESULTS: Clinical and functional results were similar between manual and CAS TKA at five years postoperative. There was no statistically significant difference between five-year postoperative pain scores, ROM, or UCLA activity scores. Mechanical axis, as measured on plain radiographs, did not reveal a significant difference between manual and CAS at one month or five-year postoperative.

DISCUSSION: This study found similar clinical, functional, and radiographic outcomes at five-year follow-up between manual and CAS TKA. These results were consistent with the short-term results found previously in the same patient cohort. We continue to believe that the learning effects afforded by working with a navigation system can lead to improvements in manual TKA technique, contributing to improved manual accuracy with regard to femoral component rotation and positioning, tibial slope, component size selection, and mechanical axis.

4. Prevalence of Vitamin D Insufficiency in Orthopedic Trauma Patients

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INTRODUCTION: Various authors have demonstrated a correlation between vitamin D deficiency and muscle weakness, fragility fractures, and fracture nonunion. Documenting the prevalence of vitamin D deficiency in orthopedic trauma patients is a first step in raising awareness among orthopedic traumatologists and further determining a screening and treatment strategy for vitamin D deficiency in trauma patients. The purpose of this study was to determine the prevalence of vitamin D deficiency or insufficiency in orthopedic trauma patients.

METHODS: A retrospective medical record review was done of all orthopedic trauma patients above the age of 18 managed at a university level 1 trauma center from January 1, 2009, to September 30, 2010, to identify patients that had a documented 25-hydroxyvitamin D level. Vitamin D deficiency was defined as a 25-hydroxyvitamin D level of less than 20 ng/ml, and insufficiency was defined as a level between 20 and 32 ng/ml.

RESULTS: 889 of 1,830 patients had a 25-hydroxyvitamin D level. Vitamin D deficiency had an overall prevalence of 39%. Combined deficiency and insufficiency had an overall prevalence of 77.4%. 18-25 year olds had the lowest prevalence of deficiency at 29.1% (p=0.25) and insufficiency at 54.7% (p=0.08). 36-55 year-olds had higher prevalence of deficiency and insufficiency, but not statistically significant. Females ages 18-25 had lower prevalence of deficiency (25%, p=0.41) and insufficiency (41.7%, p=0.16) among females. Males age 18-25 had a lower prevalence of insufficiency (59.7%, p=0.24) among males.

DISCUSSION AND CONCLUSION: Vitamin D deficiency and insufficiency were prevalent in this large population of orthopedic trauma patients. This is the largest known patient population of orthopedic trauma patients to be evaluated for vitamin D deficiency. Our study time frame of 21 months helps account for seasonal variation in the prevalence of vitamin D deficiency. Establishing the incidence of vitamin D deficiency in a trauma population raises awareness of the disease and should change screening and treatment patterns.

5. Indications, Surgical Techniques, and Outcomes Related to Arthroscopic Management of Native Shoulder Septic Arthritis

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BACKGROUND: There is little information on the outcome of arthroscopic treatment of native shoulder sepsis. Therefore, the purpose of this study was to determine the preoperative indications, intraoperative findings, and outcomes related to native shoulder sepsis treated with arthroscopy.

MATERIALS AND METHODS: We retrospectively reviewed 50 native shoulders with septic arthritis between 1994 and 2008. The average age was 66 years, with 75% of patients being male. Four patients had bilateral involvement. All underwent arthroscopic irrigation and debridement. The mean follow-up was 31 months.

RESULTS: Patients were immunocompromised in 60% of cases; 33% were diabetic. Twelve percent of patients had previous shoulder injection or surgical procedure. Twenty-eight percent of patients had a rotator cuff tear. The mean preoperative WBC, ESR, and CRP values were 13, 66, and 83, respectively. The average aspiration cell count was 110,987, with a mean differential of 87% neutrophils. Only 16% of gram stains revealed the organism of concern. The most common organisms were MSSA (44%) and MRSA (20%). Sixteen of 50 (32%) shoulders required repeat irrigation and debridement within the first week, with 10% of shoulders having drainage. Seventeen percent of patients had expired within one year. Final Gächter staging was I or II for 32 shoulders and III or IV for 14 shoulders.

CONCLUSIONS: In the largest study to date, the results indicate that the majority of patients with native shoulder sepsis are elderly and immunocompromised, with increased inflammatory markers and a supporting aspiration cell count. Most are infected with *S. aureus*. Patients and surgeons must be aware that after initial arthroscopy, one in three patients will require additional surgical intervention for resolution of their infection. Furthermore, the mortality rate is nearly 20% in the first postoperative year.

6. Readmission Following TKA: Is the Wrong "Never Event" Being Targeted?

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INTRODUCTION: Measures to improve quality of care and control costs are continually being introduced. One such initiative is the identification of "never events" whereby reimbursement for readmissions for complications considered to be largely avoidable may be decreased or eliminated in the future. One such complication is that of VTE (Venous Thromboembolism: DVT or PE) following TKA. A study was undertaken to examine the relative incidence and cost of VTE following TKA compared to other major causes of early readmission.

METHODS: A five-year retrospective study was performed of all knee arthroplasty patients using an administrative database of a large teaching hospital. Although over 700 readmissions occurred in that patient group, when readmissions were excluded that were not clearly related to the index procedure and/or occurred >90 days after the index procedure, 79 readmissions in 60 patients remained for analysis.

RESULTS: The most common reasons for readmission by far was persistent drainage or noninfectious wound complication (44.3%), followed by bleeding complication (12.7%), infection (11.4%), and limited motion (7.6%). VTE was the fifth most common cause for readmission (5.1%) with a highly significantly lower incidence than wound complications ($p<.001$). All patients were treated with some form of DVT prophylaxis accepted under SCIP Guidelines at this institution during this time period. The total cost of treating bleeding complications was eight times greater and the cost per episode of care was twice as great for bleeding related complications then for VTE.

DISCUSSION AND CONCLUSION: The most common cause of readmission following TKA was related to wound drainage and bleeding, far exceeding that of VTE in both volume and cost. Focusing on further decreasing VTE complications with more aggressive prophylaxis regimens is more likely to increase wound drainage and bleeding complications that are already the leading cause of readmission at this institution.

7. Do Ceramic on Polyethylene or Ceramic on Ceramic Hip Implants Add Value? Analysis of Survival in a Community Joint Registry

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INTRODUCTION: Surgeon preference for choice of bearing surface in total hip arthroplasty (THA) has changed over time. Traditional metal on polyethylene (MOP) THAs have known shortcomings so alternative bearing surfaces have been developed to solve these problems. Recent failures of metal on metal have made ceramic on poly (COP) and ceramic on ceramic (COC) bearing surfaces more popular. However, recent studies have failed to show significant differences in survival of these THAs.

METHODS: All COP (n=609) and COC (n=168) THAs performed in our community registry between 2002 and 2010 were compared to a group of MOP THAs (n=1,196) done in the same time frame. Analysis was performed to compare cumulative revision rates (CRR) and the risk of revision (RR) for the three groups. Analysis was done using Kaplan Meier methods and Cox regression.

RESULTS: COC/COP THAs were done in younger patients, were more expensive, had a shorter follow-up period, were more often diagnosed with aseptic necrosis, and more often had a smaller head size than the MOP THAs. There was no significant difference in the CRRs between the COP (3.0%), COC (5.6%), or MOP (3.3%) THAs (p=0.17). There was also no difference in the RR between COP and MOP THAs (hr=0.97, p=0.95) or between COC and MOXP THAs (hr=1.32, p=0.53) after adjusting for age, year of index procedure, and head size.

DISCUSSION: Alternative bearing surfaces for THA has been pursued because of component loosening/osteolysis in MOPs. Most of the evidence supporting the use of these surfaces has been from laboratory performance data. Our study showed no difference in the survival of COP or COC THAs over MOP THAs. Although longer-term follow-up may demonstrate lower rates of wear/osteolysis for COC/COP THAs, currently we cannot justify the additional cost of these components.

8. Hip Resurfacing: A Large, Single-Surgeon Experience

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Following FDA approval of the Birmingham Hip Resurfacing System in 2006, and after undertaking the mandated training, we prospectively enrolled more than 1,000 patients in an IRB-approved database and performed hip resurfacing procedures. Little practical training was available, as we chose to use the anterolateral approach, rather than the posterior approach as recommended by the developers. Instrumentation changed periodically, new instrumentation and techniques evolved, and patient selection criteria gradually expanded over time. Our post-operative protocol was somewhat conservative, including six weeks of partial weight-bearing, and avoidance of strenuous exertion for 12 months. No "hip precautions" for dislocation were required. After 12 months, no restrictions on activity, sports, running, etc. were imposed. More than 400 patients are available with minimum 2-year follow-up. Their average age was 53 (14-84), of whom 73% were male. Ninety-one percent had a primary diagnosis of osteoarthritis, 6% had overt dysplasia, and 3% had avascular necrosis. There were eight cases of single-stage bilateral resurfacing due to extreme deformity. The average femoral component size in men was 52 mm, in women 46 mm.

Harris Hip Scores were 66 preoperatively and 98 at two years follow-up. Functional limitation scores showed greater improvement than an age and gender-adjusted cohort of total hip arthroplasties.

Failures were remarkably few. We had only one case of femoral neck fracture: our case #6 with AVN who fractured while doing leg-presses eight weeks after surgery. We have had one deep infection, which was debrided with retention of components. We have had one cup loosening, one nerve injury, no femoral loosening, no dislocations, and no deaths. Our overall success rate in this series is over 99%.

We have been able to demonstrate the safety and short-term success of hip resurfacing in our practice, which has grown considerably as the demand for this procedure continues. Our results reproduce those of other centers world-wide with much longer experience using this device. Careful patient selection, technique, and postoperative management are vital.

MAOA BREAKOUT SESSION #1
TOTAL HIP
April 19, 2012

9. Uncemented Total Hip Arthroplasty Using a Type I Tapered Femoral Component in Patients with Dorr Type C Bone

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INTRODUCTION: This study evaluated the efficacy of fixation using an uncemented Type I tapered femoral component in patients with Dorr Type C bone. At an average follow-up of 16 years, no femoral component had been revised for aseptic loosening, and no stems were loose by radiographic criteria. One hip (1%) had been revised for late sepsis.

METHODS: Between 1983 and 1987, 68 uncemented THA were performed in 63 patients with Dorr Type C bone. Eight patients (eight hips) died with their femoral components in place prior to a minimum follow-up of 10 years. Radiographic follow-up at a minimum ten years was obtained on all 60 remaining hips. The mean age was 69 years (range 21-88). The mean follow-up was 16 years (range 10-27 years). All 68 hips were included in the survivorship analysis.

RESULTS: At 16 years, no femoral component had been revised for aseptic loosening, and none were loose by radiographic criteria. One well-fixed stem (1%) was revised for sepsis at ten years. Mild osteolysis was identified in two hips (3%). Survivorship analysis with revision of the femoral component for any reason as the endpoint was 98% (95% CI 0.96 to 1.00) at 26 years.

CONCLUSION: Uncemented total hip arthroplasty with a Type I tapered stem was associated with a low incidence of aseptic loosening and revision in patients with Dorr Type C bone at a mean follow-up of 16 years.

10. Accuracy of Acetabular Component Positioning in Hip Arthroplasty

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INTRODUCTION: Acetabular component malposition is linked to higher bearing surface wear and instability. This study examines the frequency in which acetabular components are placed within a predetermined target range. Surgeon and patient factors were analyzed for risk associated with placing the acetabular component outside the target range.

METHODS: We evaluated AP pelvis radiographs for every primary hip arthroplasty from 2004 to 2009 from a single institution. Cross table radiographs confirmed anteversion versus retroversion of the components. Hips without adequate radiographs were excluded. Acetabular component abduction and anteversion angles were determined with Martel Hip Analysis Suite™ software. We defined acceptable ranges for abduction and anteversion for both THA (30°-55° and 5°-35°, respectively) and SRA (30°-50° and 5°-25°, respectively). The results were compared to a previously published range.

RESULTS: From 1,753 THAs, 1,628 (93%) components met our abduction target, 1,666 (95%) components met our anteversion target, and 1,547 (88%) simultaneously met both targets. From 299 SRA, 265 (87%) components met our abduction target, 277 (93%) components met our anteversion target, and 246 (83%) simultaneously met both targets. Using multivariate logistic regression, we examined if component head size, surgical approach, surgeon experience, surgeon volume, BMI, gender, or age had an impact on accuracy. The odds ratio for high-volume surgeons was 1.99 ($p=0.002$) compared to that of the low-volume surgeons for accurately implanting the component. The odds of successful implantation decreased by 0.2 ($p<0.001$) for every 5kg/m^2 increase in BMI. Low-volume surgeons were consistent with placement using all surgical approaches. High-volume surgeons were significantly better with all approaches other than anterolateral (88% vs. 63%, $p=0.002$). All other variables had no significant effect on component placement.

DISCUSSION AND CONCLUSION: Increased odds of correct implant position were found with higher surgeon volume and lower BMI. High-volume surgeons had higher risk of malposition using an anterolateral approach.

11. Autogenous Femoral Head for Uncemented Acetabular THA Reconstruction in DDH: 20-Year Results

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BACKGROUND: There is minimal literature on long-term outcomes in regards to the use of uncemented acetabular components with the use of an autogenous femoral head for DDH. As such, the purpose of the current study was to determine the 20-year survivorship of THAs with an uncemented socket used in conjugation with a bulk femoral head autograft in patients with DDH.

MATERIALS AND METHODS: We prospectively followed 33 patients (38 hips) who underwent THA for degenerative joint disease secondary to DDH with bulk femoral head autograft and an uncemented acetabular component. Five patients had bilateral involvement. The average age was 42 years, with 85% of the patients being female. Average operative and anesthesia times were 216 and 280 minutes, respectively. The operative approach was anterolateral in 24 hips, transtrochanteric in 10, and posterior in 4. Mean follow-up was 19.1 years.

RESULTS: The survivorship free of acetabular revision was 79% at 15 years. At 20 years, the survivorship free from acetabular revision was 66%. Only one autogenous femoral head had not united at the time of revision surgery. An additional two patients underwent liner and head exchanges, while two patients underwent femoral revisions, resulting in a survivorship free from any revision of 55% at 20 years. Two additional patients experienced Vancouver B1 periprosthetic femoral fractures after trauma at an average of 11 years postoperatively. Both were treated with retention of components and plating.

CONCLUSIONS: This study demonstrated acceptable long-term results after use of an uncemented porous-coated socket fixed with screws in conjunction with a bulk femoral head autograft for DDH. This method of reconstruction provided reliable acetabular fixation. More importantly, it appeared to restore acetabular bone stock in patients with DDH since many patients with hip dysplasia are young and require additional hip operations. We continue to consider this technique for young patients with moderate anterolateral acetabular bone deficiency requiring total hip arthroplasty.

12. Survival of Uncemented vs. Cemented Femoral Stems in a Community Joint Implant Registry

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INTRODUCTION: Surgeon preference for femoral component fixation in total hip arthroplasty and the factors influencing that choice have evolved over time. We compared the cumulative revision rate (CRR) and the factors influencing survival in cemented versus uncemented femoral components in our community-based registry.

METHODS: 6,260 primary cemented and uncemented THAs were registered in our community total joint registry between 1991 and 2010. Analysis was performed to compare age, gender, cost of implant, length of stay, year of index procedure, diagnosis, revision, and revision reason for both groups. Analysis was done using Wilcoxon rank sum tests, Pearson's chi-square tests, Kaplan Meier methods, and Cox regression.

RESULTS: Complete (stem and cup) and stem only CRRs were similar between the cemented and cementless groups (p=0.70 and p=0.34), and there was no difference in risk of overall revision after adjusting for confounders (p=0.08). After adjusting for confounders, uncemented implants did show a reduced risk of stem revision; uncemented implants were 0.63 times as likely to be revised when compared to cemented implants (p=0.02). The primary reasons for revision remain dislocation, aseptic loosening, and wear/osteolysis. There were significant differences in stem CRRs for aseptic loosening and wear/osteolysis; uncemented THAs had a significantly lower stem CRR for these reasons than cemented THAs (2.4% vs. 3.6%, p=0.005). The uncemented THAs were 0.32 times as likely to have a stem revision for aseptic loosening and wear/osteolysis as compared to cemented THAs after adjustment for confounders.

CONCLUSION: The dramatic trend away from cemented fixation in all age groups has continued in our registry from over 80% cemented stems in 1996 to less than 10% in 2010. Previous studies have shown similar rates of revision for cemented and uncemented femoral stems. We demonstrate a lower risk of revision with uncemented stems in our community registry.

13. Femoral Remodeling Around Well-Fixed Cemented Charnley Total Hip Arthroplasty: A Minimum 20-Year Follow-Up Study

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INTRODUCTION: Charnley observed differences in femoral remodeling around well-fixed femoral components, but did not study the phenomenon. To our knowledge, no other investigators have quantified the remodeling characteristics around well-fixed cemented femoral components nor attempted to correlate those findings with patient demographics at minimum 20-year follow-up. The purpose of this study was to perform a quantitative analysis of the long-term femoral remodeling at minimum 20-year follow-up around well-fixed Charnley femoral components and to analyze the patient demographic variables which may be associated with the observed remodeling patterns.

METHODS: 130 primary cemented Charnley femoral components performed by a single surgeon, which were well-fixed at minimum 20-year radiographic follow-up (all had serial radiographs) were evaluated. Demographic variables included sex, age at surgery, diagnosis, body mass index, and postoperative activity level. Radiographs were digitized and a digital edge detection program was used to determine the total femoral diameter, medial cortical width, and the lateral cortical width at four levels (inferior to the lesser trochanter, the femoral component tip, half way between the above two, and 25 mm distal to the tip of the prosthesis).

RESULTS: Although the measurements followed a continuous distribution, three patterns prevailed: distal cortical hypertrophy (17.9%), pronounced endosteal bone loss (8.5%), and minimal cortical/endosteal change (73.6%). There were no significant differences between the three groups with respect to the demographic variables assessed. Distal cortical hypertrophy occurred early and had matured by 5 years postoperatively. It was also greater medial than lateral ($p<0.01$). The endosteal bone loss continued throughout the 20-year follow-up. Interestingly, the hypertrophied bone in the cortical hypertrophy group remodeled with decreased density after 15 years in a quarter of cases.

DISCUSSION: The authors noted distinct patterns of remodeling long-term around cemented femoral components. These findings should provide a comparison for long-term cementless femoral component studies.

14. Metaphyseal-Engaging Short Stem Femoral Implants: 5-Year Follow-Up

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INTRODUCTION: While various uncemented femoral implants have demonstrated clinical success in total hip arthroplasty (THA), there are still a number of issues which remain to be addressed. These include the continuing problems of proximal-distal mismatch, optimized proximal load transfer, and facilitation of minimally invasive surgery. We present the five-year clinical and radiographic performance of a CT-based custom-made metaphyseal-engaging short stem femoral implant.

MATERIALS AND METHODS: Between 2004 and 2005, 72 patients underwent 80 THAs with an uncemented metaphyseal-engaging short stem. We present the clinical and radiographic results of 69 THAs. The implant was custom-made based on preoperative CT to fit and fill the metaphysis. It was composed of a titanium alloy with a hydroxyapatite coating on a titanium plasma-spray in the proximal third of the stem. These patients averaged 61 years of age (range 22-79) and BMI of 28.9 (20.3-44.1) at follow-up.

RESULTS: Clinical performance was evaluated using the Harris Hip (HHS) and WOMAC scoring systems, both preoperatively and five years postoperatively. HHS averaged 55 (range 20-80) preoperatively and 96 (range 55-100) postoperatively. WOMAC scores average 51 (range 13-80) preoperatively and 3 (0-35) postoperatively. No cases of subsidence or perioperative fractures were observed, and no revision surgeries have been performed. Bone remodeling was typified by endosteal condensation and cortical hypertrophy in Gruen zones 2, 3, 5, and 6.

DISCUSSION: At five-year follow-up, the uncemented metaphyseal-engaging short stem is stable and exhibits proximal bone remodeling closer to the metaphysis than conventional stems. Furthermore, this device has comparable clinical performance as previously evaluated conventional and off-the-shelf short stem implants. Although we have no revisions to report, theoretical bone preservation from a proximally loaded femur remains a potential advantage to this design.

15. Results of Total Hip Arthroplasty (THA) in Patients with Lower Extremity Deficits from Polio

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INTRODUCTION: There is little mention in the literature of the results of THA in patients with deficits from polio. Literature regarding THA in other paraplegic conditions shows only modest improvement in outcome scores, but predictable pain relief. The purpose of this study is to review a single-institution experience performing THA for osteoarthritis in patients with deficits from polio.

METHODS: A single institution database of 33,731 THAs was examined and compared with hospital records of a diagnosis of polio. Patients with lower extremity strength better than 4/5 were excluded. Harris Hip scores (HHS) were recorded preoperatively and at the most recent follow-up. Neurological deficits and prior operations were recorded. Statistical analysis was carried out using Student's t-test.

RESULTS: Twenty-seven patients underwent THA in a hip affected by polio and were followed for an average eight years. Harris hip scores increased from an average 40.8 preoperatively, to 73.1 postoperatively ($p<0.001$). The pain component of the HHS increased from 17.0 to 41.8 ($p<0.001$). There were four complications, including two dislocations, one stem fracture, and one cerebrovascular accident. Forty-one patients underwent THA in a hip contralateral to a limb affected by polio and were followed for an average of 12.8 years. Harris hip scores increased from an average total 39.7 to 74.7 postoperatively ($p<0.001$). The HHS pain component increased from an average 15.6 preoperatively to 42.0 ($p<0.001$). There were four complications (10%) in this group, including two hips that became aseptically loose, one that had symptomatic heterotopic ossification, and one greater trochanter avulsion.

DISCUSSION: Results of THA in this patient population are satisfactory from a pain relief standpoint, but function does not reliably improve after surgery. Dislocation is a concern in hips affected by polio, and early failure is a concern in hips performed on the contralateral side. THA is a safe operation for these patients, with more modest gains after surgery than in a normal patient population.

16. Technique and Results of Cementless Primary THA with Corrective Femoral Osteotomy: Mean 8-Year Results

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INTRODUCTION: Proximal femoral anatomy distorted by congenital deformity or trauma may be difficult to address with most off-the-shelf components. This paper describes the surgical technique and reports the mid-term results of corrective osteotomy (shortening, derotational, angulation, or a combination) performed concurrently with primary total hip arthroplasty (THA) with implantation of a proximally porous-coated, modular component.

METHODS: The first 50 consecutive corrective osteotomies with implantation of the S-ROM femoral component were retrospectively reviewed. The underlying diagnoses included developmental dysplasia in 23 hips, post-traumatic arthritis in 7 hips, Paget's disease in 2 hips, and Perthes' disease in 4 hips. In most cases, after preparation of the femur for implantation, a uniplanar osteotomy to correct length or deformity was performed. A "timing mark" etched on the femur aids in re-alignment of the femoral portions. The proximal and distal sections were then re-approximated, and the stem is seated. In most, but not all cases, prophylactic cerclage cables are added to prevent fracture during final implant seating.

RESULTS: Forty-one hips were available for review at mean 8 years follow-up (range 4–15 years). Radiographically, all osteotomies united. There have been two revisions for sepsis. No stem is radiographically loose. Clinically, Harris hip scores averaged 92 points.

DISCUSSION AND CONCLUSION: Corrective osteotomy can be performed with this implant because of the torsional stability provided by the distal flutes. Additionally, this stem is proximally porous-coated, providing long-term stability through bone ingrowth. This relatively simple technique is effective for correction of deformity and provides excellent results at mid-term.

17. Factors Affecting Survivorship of Periacetabular Osteotomy in Patients with Hip Dysplasia

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INTRODUCTION: There are very few published mid- to long-term studies reporting on the results of PAO for management of hip dysplasia in the young adult. The objective of this study is to report the mid-term follow-up of PAO performed in this group of patients with special attention to progression of hip arthritis and conversion to total hip arthroplasty (THA).

METHODS: 266 abductor sparing PAO performed on 235 patients were performed at one institution between January 1996 and May 2006. Those with less than two year clinical follow-up were excluded leaving 135 hips in 118 patients for review. There were 21 males and 97 females with an average age at the time of surgery of 32 years. Clinical notes were reviewed for pain relief, and radiographs were reviewed for progression of hip arthritis according to criteria by Tönnis.

RESULTS: The average clinical follow-up was 82.1 months (range 2-14 years). Thirty-one of 135 hips had progression in severity of Tönnis grade. 103 hips were Tönnis 0, 19 T-I, 3 T-II, and 10 radiographs were not available for review. Postoperative grade was 0 in 87, I in 26, II in 17, and III in 4; radiographs were not available in one hip. Thirteen hips (9.6%), required a THA at an average of 82.9 months after the PAO (range 30.6-165 months).

CONCLUSION: Conversion to THA after PAO occurred in 10% of hips at an average of seven years. An additional 13% of the hips showed progression in hip arthritis on radiographs, but have not required a THA at last follow-up. Patients with symptomatic hip dysplasia and minimal radiographic arthritis should be considered candidates for a PAO, but patient selection and surgical technique are critical.

18. Tantalum Acetabular Components for THA After Therapeutic Pelvic Radiation: 5-10 Year Results

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INTRODUCTION: Pelvic radiation is commonly used in the treatment of gastrointestinal, genitourinary malignancies. Fixation failure of cemented or ingrowth acetabular components in the radiated pelvic bone is a concern. Trabecular metal acetabular components have been successfully used in these patients in the short term. We studied how these implants performed over the intermediate term.

METHODS: A retrospective review of medical records and prospectively collected joint registry data was performed. Inclusion criteria for the study was THA in patients with prior pelvic irradiation (>/=3000cGy) for genitourinary/gastrointestinal or hematologic malignancy or pelvic metastatic lesions with a minimum five-year follow-up. We used multi-hole tantalum acetabular shells with multiple screw fixation and cemented polyethylene liners. Preoperative two- and five-year Harris Hip scores (HHS) were calculated. Kaplan Meier curves and t-tests were used as a part of the statistical analysis.

RESULTS: Out of a total of 30 patients (35 hips), overall ten-year survival for patients was 50%. One patient who received a sub therapeutic radiation dose was excluded. Out of the 34 patients, 25 patients received a hybrid THA and 9 received an uncemented THA. Ten patients who died before five years were excluded from the implant analysis. None of the patients died as result of surgical complications. The mean dose of radiation was 6313 cGY, and the median time from radiation to surgery was 56 months. The median time from surgery to latest follow-up or death was 70 months, with a mean clinical follow-up of 78 months (SD: 21) and a mean radiographic follow-up of 57 months (SD: 16). The average HHS at the preoperative visit was 36 and at the latest visit was 79 ($p<0.001$). There were no revisions or clinical/radiographic failures at last follow-up in any of the patients (100% implant survival).

CONCLUSION: A durable and reliable acetabular component is needed in patients receiving a THA after prior pelvic radiation as this population has a 50% ten-year survival. The tantalum acetabular components with multiple screw fixation and cemented polyethylene liners have proven to have excellent survivorship in this cohort in the intermediate term.

19. Primary Total Hip Replacement Using Foam Metal Acetabular Cups in Patients with Extensive Periacetabular Bone Loss

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The management of extensive bone loss in the periacetabular region remains a challenging problem. Frequently, concurrent problems are also present including leg length discrepancy, soft tissue contracture, and poor regional vascularity. This study evaluates the use of foam metal-backed components in the reconstruction of patients with massive bone periacetabular bone loss due to trauma, chronic infection, and metastatic bone disease. Between January 2004 and January 2008, 39 patients were included and followed for a minimum of one year. The patients were reconstructed using titanium foam acetabular cups. A review of medical records, clinical examinations, and imaging studies were performed. Functional outcome was assessed using the Harris (0-100 scale) and Oxford Hip Scores (12-60 scale) and radiographic assessment to determine loosening and osteolysis; perioperative complications were recorded as well. Functional results were excellent (Oxford <15; Harris >90) in 35 patients, good in 3 patients (Oxford 16-30; Harris 80-90), and fair in 1 patient (Oxford 32, Harris 74). One patient was treated for a deep infection. The components were retained in this patient, and he was successfully treated with intravenous antibiotics and surgical debridement. Two of 39 exhibited a Trendelenburg gait. Thirty-six of 39 patients were ambulating without assistive devices at one year, and of the 33 patients with two-year follow-up, all were ambulating without assistive devices. Leg length discrepancy was able to be corrected in 37 or 39 to within 1 cm (range 2–5 cm; average 3.1 cm). Radiographically, 2 of 33 patients had radiographic loosening; both were noted to be loose within the initial three months following surgery. All 22 hips (100%) with four-year follow-up were radiographically stable. Foam metal backed acetabular implants appear to enhance initial stability and maintain durable bone ingrowth in patients with severely compromised bone periacetabular bone.

MAOA BREAKOUT SESSION #2
HAND
April 19, 2012

20. Perilunate Dislocations: 25-Year Experience

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HYPOTHESIS: Patients sustaining perilunate dislocations and fracture dislocations experience impaired functional outcome with associated radiographic deterioration over time.

METHODS: A retrospective review was conducted analyzing the outcome of all perilunate dislocations and fracture dislocations treated within our institution from 1985 to 2009. Standardized postoperative assessments included wrist range of motion, grip strength, and Mayo Wrist Score. Preoperative and postoperative radiographs were examined to ascertain the incidence of post-traumatic arthritis. Statistical analyses used included parametric and nonparametric t tests.

RESULTS: Ninety-four patients were treated within our institution over the last 25 years. There were 30 perilunate dislocations and 64 fracture dislocations (5 open and 89 closed injuries). Complete radiographic records were present in 57 patients. There were no statistically significant differences between the pure dislocation versus the fracture dislocation groups with respect to contralateral grip strength (64% versus 68%, respectively). Thirty-three percent of patients underwent additional secondary procedures. The pure dislocation patients went onto a higher rate of salvage procedures compared to the fracture dislocation patients (35% versus 5%). According to the Mayo wrist scores, 23% of patients had good to excellent results and at final follow-up, only 59% of patients returned to work indicating the significant morbidity associated with this injury. Radiographic analysis demonstrated signs of degenerative changes in both injury groups (35% dislocation only and 52% fracture dislocation patients). At latest follow-up, 16 of 20 and 31 of 37 patients within the dislocation and fracture dislocation groups, respectively, had evidence of greater than one third of ulnar translocation of the lunate.

CONCLUSION: Perilunate dislocations and fracture dislocations result in significant morbidity and impaired functional outcome in patients over the long-term.

21. Efficacy and Patient Satisfaction of Splinting for Basal Joint Arthritis

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BACKGROUND: Surgical management of osteoarthritis of the carpometacarpal joint of the thumb can involve a variety of procedures such as osteotomy, trapeziectomy, or arthroplasty. However, treatment often begins conservatively with splinting, anti-inflammatories, and hand therapy. Although splinting for basal joint arthritis is commonplace, there is a lack of literature describing the natural course of its use. The purpose of this study was to evaluate the effectiveness as well as the pattern of use of splints for basal joint arthritis.

METHODS: 150 patients who were treated with a custom made splint for basal joint arthritis from 2006-2010 were identified and surveyed. Pain, duration of use, patient satisfaction, and outcomes were recorded for all patients.

RESULTS: Survey results were obtained in 110/150 patients. The average age of patients was 61.9 years with 80 females and 30 males. The average pain prior to initiation of splinting was 7.7 on a scale of 0-10 (0, no pain and 10, excruciating pain). The average pain after splint use was reduced to 4.0. The average duration of use was 5.5 months (range 2-8 months) with 75% of patients reporting that they were able to wear the splint greater than four hours per day. After the course of splinting, 76% of patients reported that that they were either satisfied or very satisfied. Sixteen percent were fairly satisfied, and only 8% were unsatisfied with the splint. Seventy percent of patients also did not require any further treatment. However, 5% went on to undergo surgery, 9% had injections, 8% returned to therapy, and 8% utilized other pain management modalities.

CONCLUSION: Although prolonged use of a splint can be an inconvenience to patients, they can be extremely satisfied with its effectiveness. Splinting can be attempted prior to and also be an alternative to surgical intervention.

22. Predynamic and Dynamic Proximal Carpal Row Injuries

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PURPOSE: Currently, there is limited information regarding the clinical outcomes of percutaneous pinning of proximal carpal row injuries. The purpose of this study is to compare percutaneous pinning and capsulodesis of dynamic or predynamic proximal carpal instability versus pinning alone.

METHODS: We identified all patients with predynamic or dynamic scapholunate or lunotriquetral ligament injury who were treated with percutaneous pinning alone or in conjunction with dorsal capsulodesis. We excluded high-energy mechanisms, tenodeses, or screw-association procedures. Patients' charts were evaluated for injury duration, fracture, debridement, thermal shrinkage, and reconstruction, as well as pre- and postoperative scapholunate diastasis, radioscaphoid, scapholunate angles, Mayo Wrist Scores (MWS), and Visual Analog Scale (VAS).

RESULTS: Sixty-two patients were identified with an average follow-up of 23.6 months. Postoperative immobilization averaged 6.6 weeks. Twenty-seven patients were treated acutely with percutaneous pinning of the proximal row with or without open ligament repair and had pre- and postoperative VAS and MWS of 5.5 and 58.9; and 1.8 and 72.3, respectively. Thirty-five patients treated at greater than six weeks had pre- and postoperative VAS and MWS of 4.5 and 67.3; and 2.4 and 70.7, respectively. Thirty-eight patients treated with pinning alone had a pre- and postoperative MWS of 64.7 and 71.3 compared to the 24 treated with pinning and capsulodesis MWS of 59.2 and 69.6. The patients treated with pinning alone for an acute injury had MWS of 58.9 and 63.3, compared to 67.3 and 70.7 for chronic injuries. Patients with concomitant distal radius fracture 12 (19%) had significantly higher MWS (81.3, p=0.04), than those without (68.4). The average pre- and postoperative scapholunate intervals measured 1.9 mm and 2.1 mm and scapholunate angles were 58.6° and 62.5°.

CONCLUSIONS: We conclude percutaneous pinning of dynamic and predynamic proximal carpal row injuries does not significantly improve clinical outcomes, except with concomitant distal radius fractures.

23. Scaphoid Malunion: Outcomes of Corrective Osteotomy Compared to Salvage Procedures

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INTRODUCTION: Scaphoid fractures are common and many times require prolonged immobilization or surgical fixation for union. Although a nonunion often complicates this fracture, union alone may not be sufficient enough for good clinical outcomes.

METHODS: A retrospective review was conducted analyzing the outcome of all scaphoid malunions treated at a single institution over a 20-year period. All patients were diagnosed with a scaphoid malunion by radiographs/tomograms. Standardized preoperative and postoperative assessments included wrist range of motion, grip strength, and the Mayo Wrist Score. Intrascaphoid and carpal angles as well as arthritis of the wrist were evaluated preoperatively and at final follow-up.

RESULTS: Thirty patients were diagnosed with a scaphoid malunion. Twenty-one patients underwent surgical intervention, and of those, 18 had appropriate follow-up for an average of 29.7 months (range 2-140 months). Nine patients had undergone previous intervention of bone grafting for treatment of scaphoid nonunion. Ten patients underwent corrective intrascaphoid osteotomy with nine autografts from the iliac crest and one vascularized medial femoral condyle autograft. Five patients underwent cheilectomy and/or radial styloidectomy; five had a scaphoidectomy with a midcarpal fusion. Nine patients opted against surgical intervention. The average initial lateral intrascaphoid angle (LISA) was 46° and did not significantly differ between groups. Average preoperative to postoperative change in grip strength and Mayo wrist scores respectively for corrective osteotomy were 4 kg (range -15 to 23) and 6.1 (range -20 to 30), for less invasive procedures 11.3 kg (range 4 to 20) and 25 (range 20 to 30), and for scaphoidectomy with midcarpal fusion 7.3 kg (range 2 to 16) and 25 (range 15 to 35).

CONCLUSION: An attempt at restoring wrist biomechanics with an osteotomy may not improve long-term clinical outcomes when compared to salvage procedures. Proceeding with osteotomy in the younger patient with a malunion, but minimal to moderate symptoms, continues to present a particular dilemma to the surgeon.

24. Needle Aponeurotomy Treatment of Dupuytren's Contracture

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Needle aponuerotomy is an office-based procedure in which a small hypodermic needle serves as the scalpel blade to divide the contracted palmar fascia percutaneously under local anesthesia. A popular treatment in France and other European clinics for three decades, it was introduced here eight years ago. Contrasted to open surgical care there is quick recovery, minimal pain, and a lower incidence of RSD, flare reaction, and nerve injury. Patients can usually resume manual work and sports within a week. As in fasciectomy, recurrence of contracture is common, but the needle release can usually be repeated to restore function. Total cost of care is a fraction of that for traditional surgery. My four-year experience treating more than 400 hands has shown high patient enthusiasm for this treatment option. The technique, results, and complications will be presented in detail.

25. A "Danger Zone" for Radial Nerve Injury: An Anatomic Study

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INTRODUCTION: Despite numerous anatomic studies, iatrogenic injury to the radial nerve during operative fixation of the humerus continues to be a clinical problem. We sought to further improve the understanding of the nerve course through the brachium. We further hypothesized that there exists a poorly appreciated "danger zone" for nerve injury where it runs along the lateral cortex of the humerus proximal to its transit through the lateral intermuscular septum.

MATERIALS AND METHODS: Twenty-five fresh frozen cadavers were utilized (14 males, 11 females). A posterior skin incision was made, with the elbow flexed to 90° and the triceps exposed. A 2 mm guide wire was drilled into the humerus, in a perpendicular fashion, through the tip of the triceps tendon proximally. The pin was removed, the radial nerve dissected out, and the relationship to various anatomic landmarks measured with a digital caliper.

RESULTS: There is a 6.7 cm (2.9-11.1 cm) span of radial nerve that lies directly on the periosteum of the humerus before piercing the lateral intermuscular septum. The proximal 4.5 cm (2.0-6.4 cm) abuts the posterior cortex while the final 2.2 cm (0.9-4.6 cm) segment, just proximal to the lateral intermuscular septum, sits on the lateral humeral cortex. The nerve at the midpoint of the humerus posteriorly was 1.7 cm (0.2-3.9 cm) proximal to the level of the tip of the triceps tendon.

DISCUSSION AND CONCLUSION: The radial nerve lies directly on the lateral humeral cortex for an additional 2 cm proximal to its transit through the lateral intermuscular septum. Awareness of this "danger zone" may help prevent iatrogenic injury, especially when applying an external fixator. The tip of the triceps tendon appears to be a consistent and practical landmark to help determine the location of the radial nerve during operative fixation from a posterior approach with the nerve never being distal to this level.

26. Early Results of Distal Radius Hemiarthroplasty with Combined Proximal Row Carpectomy♦

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BACKGROUND: Severe wrist arthritis is most commonly treated with wrist arthrodesis. This procedure provides predictable pain relief, but there is loss of motion that may reduce a patient's ease of function. Total wrist arthroplasty (TWA) is a motion preserving option, but is usually reserved for low demand patients. TWA has not gained the acceptance of arthroplasty for the hip, knee, or shoulder. This is partially because of the restrictions placed on TWA patients and complications, especially with the distal component. We propose a novel motion preserving approach to severe wrist arthritis with a procedure combining a proximal row carpectomy (PRC) and a distal radius implant hemiarthroplasty that does not significantly restrict activities.

METHODS: We reviewed all patients with the combined PRC distal radius hemiarthroplasty procedure. They were examined with clinical range of motion as well as outcome measures including SF-36, Disabilities of the Arm, Shoulder, and Hand (DASH), and patient-rated wrist evaluation (PRWE). All procedures were performed by a single surgeon through a dorsal approach. A distal radius component from the Universal 2 TWA system was used for the procedure.

RESULTS: The operation was performed on 24 wrists in 22 patients (10 female and 12 male) with average age of 59.4 years. Average follow-up was 20.3 months (4-41 months). Overall, there was reduction in pain scores and preservation of range of motion. There was one minor wound complication treated with dressing changes. One patient with severe rheumatoid arthritis had increasing pain and erosions and was revised to a wrist fusion at 24 months.

CONCLUSIONS: Early results of the novel combined distal radius hemiarthroplasty and proximal row carpectomy show promise in relieving pain and preserving motion. Longer-term follow-up studies will need to be done to see how the procedure will perform over time.

27. Functional Outcomes of Distal Biceps Ruptures Using a Cortical Button Technique

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Curtis R. Noel, M.D.	Akron, OH

INTRODUCTION: Distal biceps tendon ruptures lead to a loss of supination and flexion strength. Multiple techniques exist to repair these injuries. Several biomechanical studies show cortical button repair has the highest load to failure when comparing repair techniques. We hypothesize that repair of distal biceps ruptures using cortical button fixation restores strength and motion in a reliable manner when assessed at a minimum of one-year follow-up.

METHODS: This is a single cohort study of 21 patients, who underwent cortical button repair of distal biceps ruptures and were then tested at a minimum of one-year follow-up. The senior author performed 73 consecutive repairs and 43 of these met inclusion criteria. Twenty-one patients followed up for evaluation to assess pain, functional scores, range of motion, and strength.

RESULTS: The average age of patients at injury was 50 years and time to follow-up after repair averaged two years. Three patients reruptured the distal biceps tendon after surgery and did not undergo further testing. All patients were subjectively satisfied reporting no pain, with an average DASH score of 4.635. No statistical differences existed in range of motion or strength, comparing operative to nonoperative sides. Elbow flexion/extension averaged 1-140° for both sides. Forearm supination/pronation averaged 83-90° on the operative side and 86-90° on the nonoperative side. Average isometric elbow flexion strength was 43.7 lbs on the operative side and 43.4 lbs on the nonoperative side. Isometric forearm supination strength was 27.5 lbs on the operative side and 32.3 lbs on the nonoperative side. Dynamic strength data showed no statistical difference between sides. Complications were consistent with other reports in the literature.

CONCLUSION: Cortical button repair of distal biceps ruptures has been shown to be one of the strongest fixation methods biomechanically and has also demonstrated good clinical outcomes. Our study showed that at an average follow-up of two years, patient satisfaction, pain, range of motion, and objective strength measurements show good outcomes with no statistical differences when comparing operative to nonoperative arms.

28. Four Corner Fusion with a Dorsal Circular PolyEther-Ether-Ketone (PEEK-Optima) Plate

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(Presented by David B. Jones, M.D., Rochester, MN)

INTRODUCTION: Many different fixation techniques are utilized for four corner fusion. The purpose of this study was to evaluate the rate of union with a dorsal, circular polyether-ether-ketone (PEEK-Optima) plate for four corner fusion.

METHOD: A retrospective review was conducted of all patients who underwent four corner fusion with a dorsal, circular PEEK-Optima plate at our institution from January 2005 to May 2009. Primary outcome measure was radiographic and clinical union. Secondary outcome measures were the necessary components to calculate Mayo wrist scores (pain and range of motion).

RESULTS**:** During the study period, 24 patients underwent four corner fusion with a dorsal, circular PEEK-Optima plate. The mean clinical follow-up was 16 months. Union was achieved in 23 of 24 patients (95.8%) at a mean time of 3.1 months (range: 1-12 months) from surgery. Pain levels improved in 20 of 24 patients (83.3%). Passive range of motion after four corner fusion, as compared to the uninjured wrist, was 59.2% of volar flexion, 52.8% of dorsiflexion, 107.4% of radial deviation, and 43.6% of ulnar deviation at final follow-up. Mayo wrist scores were calculated for 15 patients (excellent – 2, good – 5, fair – 5, and poor – 3). Revision procedures were necessary in 3 patients (four corner nonunion revision – 1, total wrist arthrodesis for global carpal instability – 1, and progressive painful radiolunate arthrosis – 1).

CONCLUSION: Four corner fusion with a radiolucent, dorsal circular PEEK-Optima plate results in high union rates with improvements in pain.

29. Accuracy and Reliability Testing of the Mayo Elbow Performance Score

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INTRODUCTION: The Mayo Elbow Performance Score (MEPS) is a widely used instrument to evaluate clinical outcomes for a variety of elbow disorders. However, there are no studies to confirm its validity as an outcomes tool. We proposed to test the reliability of the MEPS and compare it to a validated outcomes instrument, the American Shoulder and Elbow Surgeons (ASES) score.

METHODS AND MATERIALS: Forty-two patients who presented to a single surgeon with the chief complaint of elbow dysfunction comprised the study cohort. Patients with an immediate surgical indication and those that underwent injections or other substantive treatment at the index visit were excluded. At the initial visit, patients completed a MEPS questionnaire. Patients then returned two to three weeks later for a repeat evaluation. Two weeks was chosen as this is a recognized interval where significant changes in clinical condition are unlikely to occur yet patients are also unlikely to accurately recall the evaluation forms. At the second visit, patients completed both a MEPS questionnaire and were also evaluated with the ASES elbow score. Statistical analysis for reliability and accuracy were calculated using two-tailed Pearson correlation coefficients with 95% confidence intervals. Pearson coefficients greater than 0.8 were considered to indicate near-perfect agreement.

RESULTS: The average MEPS score at the initial visit was 58 (range 20-95, 95% CI 52.6-63.3, SD 17.4). At the second visit, the average MEPS score was 68.5 (range 30-100, 95% CI 62.7-74.2, SD 18.8), and the average ASES score was 77.9 (range 29-100, 95% CI 72.2-83.7, SD 18.7). The Pearson coefficient for MEPS scores at the two time points averaged 0.82, indicating near-perfect agreement. The Pearson coefficient between the MEPS and ASES scores was 0.83 indicating near-perfect agreement between the tests.

CONCLUSION: The Mayo Elbow Performance Score has near-perfect reliability when assessed at different time points and when compared with a validated elbow outcomes instrument. Differences in compared scores averaged approximately ten points indicating some small degree of patient improvement between time points. However, 95% percent confidence intervals, standard deviations, and ranges were essentially equivalent between and among tests, indicating similar accuracy. We conclude that the Mayo Elbow Performance Score is a reliable outcomes instrument for clinical studies of elbow function.

30. Local Pedicles of the Hand and Digits

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The most readily adaptive pedicles are the palmar and cross finger grafts. Digital joints must be supple with no evidence of arthritis or connective tissue disease.

The palmar pedicle may be located thenar, midpalmar, or hypothenar, but there should be no stress on the pedicle base. The graft can be completely detached 12-14 days post application, and multiple grafts can be applied simultaneously. These grafts provide excellent resurfacing for any digital tip amputation with protruding bone and are particularly suited to maintain complete functional digital length in the child. The donor site is not resurfaced; both the McCash open method to treat severe Dupytren's contraction release in the palm, and drainage of a large palmar abcess prove this tenet.

The dorsal cross finger method also may be based variably and offers greater versatility particularly after flexion contracture release: the donor site must be resurfaced, however.

This series of 50 patients and 54 grafts includes 26 palmar and 28 dorsal cross finger pedicles and are equally used in the acute injury and reconstruction.

These grafts should be used sparingly (e.g. one to two per year in 35 active years of hand surgery). The long and ring fingers were most commonly involved.

MAOA BREAKOUT SESSION #3
TRAUMA
April 19, 2012

31. The Effect of Port Size Following Irradiation for the Prevention of Heterotopic Ossification After Acetabular Fracture Surgery

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PURPOSE: Radiation therapy has been shown to be an effective technique to prevent the formation of heterotopic ossification (HO) following acetabular surgery. The dose of radiation given for HO prophylaxis is standardized; however, the port size that is used to deliver the radiation varies among radiation oncologists who oversee these treatments. Smaller port size, thereby minimizing patient radiation exposure, is desirable. The purpose of this study was to evaluate the effect of port size on HO formation. Our hypothesis was that port size has no significant effect on HO formation.

METHODS: In this IRB approved retrospective investigation, 95 patients treated since 2006 were identified using the Radiation Oncology patient registry for inclusion in this study. All patients received a single 700cGy dose of radiation in the early postoperative period. The patients were separated into two groups of 40 and 55 based on the port size of their radiation treatment; small (<10 cm^2) and large (≥ 10 cm^2) port size, respectively. Patient demographic data were reviewed. The magnitude of HO formation was determined from AP, obturator oblique, and iliac oblique pelvic radiographs obtained at a minimum of 3 months postoperatively using the Brooker and modified Brooker classification systems. With these systems, the amount of HO formation was graded from 0 to IV.

RESULTS: The mean port size for the small group was 9.1 cm^2 (SD 0.44) and 11.9 cm^2 (SD 1.17) for the large group. In both small and large groups, the majority of patients had a Brooker score of 0 (64.1% and 61.8%, respectively). In the small group, there were 26 patients with a Brooker score of 0, 10 with a score of I, and 4 with a score of II. Comparatively, in the large group, 34 patients had a Brooker score of 0, 13 with a score of I, 6 with II, and 2 with III. There were no patients in either group with a Brooker IV classification. Using the modified Brooker classification, the small group had 15 patients with a score of 0, 14 with a score of I, 10 with a score of II, and I with a score of III. In the large group, 15 patients had a modified Brooker score of 0, 18 with a score of I, 16 with II, 5 with III, and 1 with a score of IV. There was no statistical difference in HO formation between the groups ($p > 0.05$, using a two sample t-test). A post hoc power analysis was performed, showing >80% power in this study based on the group sizes. Further statistical evaluation using a ROC analysis showed that the 10 cm^2 cutoff between small and large port size was indeed the most appropriate.

CONCLUSION: There is no difference in the extent of HO formation at a minimum of 3 months postoperatively after acetabular surgery treated with prophylactic irradiation using a small or large sized radiation port. Therefore, use of a smaller radiation port size is recommended, thereby minimizing radiation exposure to the patient without diminishing radiation treatment effectiveness.

32. Percutaneous Retrograde Posterior Column Acetabular Fixation. Is the Sciatic Nerve Safe? A Cadaveric Study

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PURPOSE: Percutaneous screw fixation has been advocated for minimally displaced posterior column acetabular fractures with the potential benefit of allowing early mobilization and preventing further displacement. This is particularly useful when there is an associated anterior column fracture to avoid more extensile exposure and in polytrauma cases where multiple associated extremity fractures warrant early mobilization and possibly fixation. Little has been published on the safety of the retrograde technique, especially with regards to neurological structures. The purpose of this cadaveric study was to determine the proximity of the neurologic structures to the path of the screw inserted percutaneously utilizing a guide wire into the ischial tuberosity. Our hypothesis was that the sciatic nerve is at a safe distance from the trajectory of the screw.

METHODS: Ten screws were inserted percutaneously in ten limbs (five cadavers) under fluoroscopic guidance. Dissection was then performed to expose the head of the screw as it entered through the ischial tuberosity and was then extended laterally to expose the sciatic nerve, the inferior cluneal, and the posterior cutaneous nerve of the thigh. The distances from the head of the screw to these neurological structures were measured. The axis of inclination of the guide wire was also noted to determine the ideal pathway.

RESULTS: The distance from the center of the screw head to the sciatic nerve averaged 6.3 cm (range, 4-7 cm). The average distance between the center of the screw head and the posterior cutaneous nerve of the thigh was 5 cm (range, 3-6 cm). The inferior cluneal branches were the closest to the path of the screw with an average distance of 0.3 cm in seven specimens (range, 0.1-0.6 cm) and were injured by the screw in two and could not be located in another specimen. The inclination of the guide wire was approximately 15° from the midline in both the sagittal and the coronal planes.

CONCLUSION: The sciatic nerve and the posterior cutaneous nerve of the thigh appear to be safe during retrograde percutaneous screw fixation of a posterior column acetabular fracture through a central entry point in the ischial tuberosity and following the inclination shown in this study. However, care must be taken to avoid injury to the inferior cluneal nerves.

33. Effect of Initial Postoperative Visit X-rays on Treatment Plans and Costs

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BACKGROUND: Routine imaging accounts for a significant portion of annual health care expenditures, and among orthopedic surgeons, it is a common practice to obtain radiographs at the first outpatient postoperative visit after acute fracture repair. There is a paucity of literature that investigates the benefits and necessity of such practices. We hypothesize that this practice is unnecessary and causes increased cost to the health system, unnecessary radiation exposure, and provides no effect on patient management.

METHODS: A retrospective review of patients sustaining acute fractures requiring operative fixation was done to determine how often a radiograph taken at the first postoperative visit resulted in a change in patient management, cost, and how much radiation exposure patients received.

RESULTS: A total of 200 fractures from 171 patients were included in the study. Fifteen fractures had a clinical indication for a radiograph. Only three of these fractures required change in patient management. These postoperative changes were based on history and physical exam. There was only one radiographic change from the immediate postoperative x-ray to the radiograph taken at the first clinic visit, but it did not cause a change in management. Mean radiation exposure per x-ray view was 0.164 mSv. Average charge per x-ray was $335.13.

CONCLUSIONS: Our study results suggest that a radiograph taken at the first postoperative visit after acute fracture fixation does not lead to changes in patient management and places a financial burden on the health care system. Future studies to establish guidelines on when to obtain postoperative radiographs in this setting are needed and would aid in improving the efficacy of these images.

34. Intermediate Term Follow-Up of a Large Series of Femoral Head Fractures

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INTRODUCTION: The purpose of this study is to review our experience in managing patients with femoral head fractures at a level 1 trauma center over the past 15 years. We believe this is the largest single surgeon case series of its kind.

METHODS: We conducted a computerized search of our medical record system to identify all patients with femoral head fractures that were treated at our institution between 1995 and 2010. Their records and x-rays were reviewed to determine age, sex, co-morbidities, mechanism of injury, fracture type, treatment method, complications, and outcomes based on the Thompson-Epstein Radiographic and Clinical Scale at the patient's last follow-up visit, or last visit before undergoing secondary arthroplasty.

RESULTS: Eighty-five patients were identified, and 59 had both initial and follow-up radiographs available for review. There were 39 males and 20 females with an average age of 40 (range 14-78). The mechanisms of injury were traffic accident (43), fall (7), blunt force/crush (3), sporting (4), and unknown (4). Fifty-three patients had associated injuries. Average follow-up was 24 months (range 1 month to 13 years). Initial treatment consisted of 21 with internal fixation, 16 non-operative, 8 total hip arthroplasty, and 8 with debridement. Of the 51 patients that did not undergo primary arthroplasty, 7 (14%) underwent late total hip arthroplasty secondary to post-traumatic arthritis. Of the 48 patients classifiable via the Thompson-Epstein Radiographic and Clinical scale, there were 4% excellent, 26% good, 37% fair, and 26% poor results. Thirty-five (59%) patients had a complication, either due to injury or treatment. Of these patients, 18 (51%) were minor and 17 (49%) were major.

DISCUSSION: Femoral head fractures have a guarded prognosis even in the hands of an experienced surgeon and have a high associated complication rate.

35. Incidence of Radiographic Cam-Type Impingement in Femoral Neck Fractures Treated with Reduction and Internal Fixation

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PURPOSE: Cam-type femoroacetabular impingement is recognized as a cause of degenerative hip arthritis and is caused by structural abnormalities of the hip including malunion of femoral neck fractures after internal fixation. The purpose of this study is to identify the incidence of femoroacetabular impingement in this population.

METHODS: Seventy OTA 31B hip fractures treated with internal fixation were identified from our institutional trauma database. Injury and radiographs at final follow-up were reviewed. Femoroacetabular impingement was evaluated by measuring the alpha angle and femoral head retroversion on lateral radiographs and femoral head sphericity was measured on AP and lateral radiographs with a Mose template.

RESULTS: Alpha angle was elevated in 32 hips (46%), asphericity was present in 46 femoral heads (65%), and femoral head retroversion was present in 26 hips (37%). Displaced subcapital fractures (OTA 31B3) had the highest rate of elevated alpha angle 63%, head retroversion 47%, and head asphericity 68%.

CONCLUSION: Rates of radiographic impingement are higher than expected based on population-based controls. Surgeons must be vigilant about reduction and fixation of femoral neck fractures, especially OTA 31B3 type. Malunion should be recognized, as early intervention may be beneficial in improving outcomes.

36. Functional Outcomes of Surgically Treated Lateral Compression Fractures of the Pelvis

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PURPOSE: Lateral compression (LC) pelvic fractures are the most common pelvic ring injury. Instability, pain, and deformity are relative operative indications. The purpose of the study was to determine if injury pattern, demographics, fixation method, final posterior displacement, L5-S1 involvement, associated injuries, and time influenced functional outcome measurements of operatively treated lateral compression pelvic ring injuries.

METHODS: A retrospective review of prospectively gathered data from 119 consecutive patients (52 males, 67 females), mean age 39 years, BMI 27 kg/m², with radiographically and clinically unstable LC injuries (Tile B 2&3) were operatively treated in one level 1 trauma center. All patients underwent clinical examination, radiographic imaging, and completed the SMFA at intervals of 6, 12, and 24 months.

RESULTS: Fractures were classified as Tile and AO/OTA B2 (99) and B3 (20). No statistically significant differences in SMFA subscores were found for patients ≥ 60 years old ($p > 0.05$). No significant differences were found for patients with BMI < 30 kg/m² ($p > 0.05$). Posterior reduction quality was excellent in 83.2% and good in 16.8%. The Matta grade of reduction did not correlate with any functional outcome measurement at any time interval ($p > 0.05$). 20.2% involved the L5-S1 facet and the sacrum. Persistent urologic problems were present in nine (7.6%). Deep infection was found in 9.1%, but was significantly related to degloving injuries. Statistically significant functional outcome differences were present with additional lower extremity injuries. Patients with lateral compression fractures reported significantly impaired SMFA scores compared to the general population.

CONCLUSION: Diagnosis of the posterior injury pattern is essential. Surgical procedure must be adapted to the posterior injury pattern. Appropriate surgical treatment leads to reliable functional and clinical outcome. Additional lower extremity injury influences clinical outcome especially in the mechanical relevant subscores over the studied two-year period.

37. Acetabular Retroversion as a Contributing Factor in Simple Posterior Hip Dislocations

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INTRODUCTION: Hip position, force vectors, and femoral anatomy have been factors implicated in determining why some patients sustain pure hip dislocations while others experience fracture-dislocations. Acetabular anatomy has not yet been examined. In this study, we examine acetabular retroversion as a possible contributing factor to simple posterior hip dislocation.

METHODS: Skeletally mature patients presenting to a single institution over a two-year period who sustained a simple posterior hip dislocation were retrospectively identified. AP pelvis radiographs were standardized using the validated Hip-to-Norm software, which normalizes pelvic orientation and corrects for rotation. The radiographs were reviewed by two senior level fellowship trained orthopedic traumatologists for the presence of a “cross-over sign”, signifying retroversion of the acetabulum.

RESULTS: Sixteen patients with 17 posterior hip dislocations without fracture were identified. Eleven patients (12 dislocations) had radiographs remarkable for a crossover sign. Nine of these patients had isolated posterior hip dislocations, with no other injuries identified. No patient had an ipsilateral knee dislocation. Twelve of these patients’ (13 hips) injuries occurred as a result of a motor vehicle collision, the other three patients were injured playing football or soccer, and one was a result of a fall from height.

CONCLUSIONS: In our retrospective study, a high percentage of simple posterior hip dislocations are associated with acetabular retroversion. The decreased posterior coverage of the hip joint may suggest a potential alternate mechanism for hip dislocation.

38. Geriatric Acetabular Fractures: Outcomes After Operative Fixation

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INTRODUCTION: The incidence of acetabular fractures in the elderly is rising with our aging population, but the best treatment option remains unclear. The objectives of this study were (1) to document the outcomes of operatively stabilized acetabulum fractures in the geriatric population (≥ 60 years of age) at a single Level 1 trauma center and (2) to document any predictors for unfavorable outcomes in this population related to death or conversion to total hip arthroplasty (THA).

METHODS: A retrospective review of medical records and radiographic imaging was completed and combined with prospective collection of physical examination and functional outcome surveys for surviving patients with an intact native hip. Survival analysis was performed with endpoints of both death and conversion to THA. All data were analyzed to determine statistical significance in relation to poor outcomes.

RESULTS: Seventy-five patients met inclusion criteria and had adequate follow-up from 2001 to 2009. At the time of the study, 28 were deceased, 8 had converted to THA, and 39 patients had an intact native hip after operative fixation. One-year mortality rate was 20%. Age was the only statistically significant demographic factor predictive for mortality (p=0.002). While controlling for age and gender, independent variables related to patient health status and injury severity were analyzed and no significant results were identified. Conversion rate to THA was 17% among surviving patients and all were converted within 19 months postoperatively. The presence of an irreducible hip dislocation prior to surgery was the only significant predictor of future conversion to THA (p=0.026). Conversion to THA was not statistically related to accuracy of fracture reduction (p=0.53). Nine patients completed physical examination and their results showed a decrease in global hip range of motion compared to the uninjured hip.

CONCLUSIONS: Displaced acetabulum fractures in older patients remain a difficult problem to treat. In our study, the one-year mortality rate was 20%. The presence of an irreducible hip dislocation was the only significant predictor of ORIF failure.

39. Biomechanical Evaluation of Trans-Sacral, Trans-Alar, and Iliosacral Screw Fixation for Comminuted Transforaminal Sacral Fractures

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PURPOSE: To evaluate the biomechanical stability of trans-sacral and trans-alar screw fixation versus standard iliosacral screw constructs for stabilization of comminuted transforaminal sacral fractures with or without anterior ring fixation.

METHODS: Comminuted transforaminal sacral and rami fractures were created in synthetic pelvis models. Each pelvis was stabilized by either: (1) two iliosacral screws, (2) one trans-sacral and iliosacral screw, or (3) one trans-alar screw and iliosacral screw, or by the addition of an anterior inferior pelvic external fixator to create groups 4-6. Eighteen instrumented pelvic models were tested to simulate physiologic single-leg stance with S1 unconstrained when subjected to increasing magnitude: cyclic torque, then cyclic axial force, followed by axial loading to catastrophic failure. 3D relative motion across the sacral and rami fractures and of screws relative to bone was measured with an optical tracking system.

RESULTS: Torsional failure of groups 1-3 initiated as bone crushing of the iliac cortices at the screw head-shank interfaces, and screw alternating push in-pull out in the ipsilateral ilium with torque reversal, resulting in increased transverse plane rotation of the sacrum relative to the ipsilateral ilium, and opening/closing of the rami fracture. The anterior external fixator significantly reduced the transverse plane rotation. Axial load failure of groups 1-3 continued as additional bone crushing at the screw head-shank interfaces, leading to flexion of the sacrum relative to the ipsilateral ilium about a medial-lateral axis in the vicinity of the screw heads. Catastrophic failure occurred as fracture of the ipsilateral ilium, typically through a screw site. Relative motion between sacrum and the screws was small, inferring that screw/sacral bone interface remained in intact. Differences in stiffness were not statistically significant.

CONCLUSION: Construct failure appeared similar to clinical cases, inferring realistic *in vivo* simulation. Failure was due to localized bone failure and screw motion in the ipsilateral ilium and not in the sacrum, and was less likely to occur with rami fixation. Therefore, posterior and anterior pelvic fixation should be considered in these patients.

40. Comparison of Standard Iliosacral Screw Fixation to Trans-Sacral Locked Screw Fixation in a Type C – Zone II Pelvic Fracture Model

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PURPOSE: Although iliosacral screw fixation into the first sacral body is a preferred method for posterior fixation of sacral fractures, this construct has been shown to be clinically unreliable for the percutaneous stabilization of Type C-zone II pelvic injuries in which residual fracture site separation exists. In this study, a pelvic fracture model reproducing this situation was used to biomechanically evaluate the performance of a locked trans-sacral construct versus the standard iliosacral fixation construct.

METHODS: Ten intact embalmed cadaver pelvises including the attached 4^{th} and 5^{th} lumbar vertebra were obtained. To ensure uniformity in bone density between the tested groups, DEXA scans were performed and the specimens were randomized accordingly. A type C–pelvic ring injury was created by making thin blade saw cuts through zone II of the sacrum and the ipsilateral superior and inferior pubic rami. The zone II sacral injury was then reduced maintaining a 2 mm fracture gap using a calibrated spacer. Five specimens underwent definitive fixation using two cannulated 7.0 mm iliosacral screws into the S1 body (standard iliosacral group); the remaining five specimens underwent fixation using one cannulated 7.0 mm iliosacral screw into the S1 body and one cannulated extra-long 7.0 mm cancellous trans-sacral screw exiting the contralateral ilium (trans-sacral group). A nut was placed on the end of this trans-sacral screw creating a locked construct. The disrupted ipsilateral rami were not stabilized. Each pelvis was then mounted on an MTS machine in a unilateral stance testing model. The pelvises underwent 100,000 cycles at 250N and then loaded to failure. Failure was defined as the point on the load–displacement curve at which force measurement declined rapidly toward zero with no further change in displacement. The displacements at 25, 50, 75, and 100K cycles and failure force were recorded for each pelvis; the differences between the two groups were then compared using the Mann-Whitney U test.

RESULTS: The mean displacements at 25, 50, 75, 100k cycles and force to failure for the iliosacral group were 5.1 mm, 9.6 mm, 15.5 mm, 19.7 mm, and 825 N respectively. Comparatively, the values for the trans-sacral group were 3.6 mm, 5.5 mm, 10.2 mm, 15.5 mm, and 1056 N. There was a significant difference (p value <0.05) of the displacements at all measured intervals (25, 50, 75, and 100K cycles) and the force to failure between the iliosacral and trans-sacral groups, the trans-sacral group pelvises showing less displacement and requiring a greater force to failure.

CONCLUSION: Our biomechanical study showed that fixation of Type C - zone II pelvis injuries using the combination of an iliosacral screw and a locked trans-sacral screw minimized fracture displacement and required a larger force to failure when compared to posterior fixation with two standard sacroiliac screws.

41. Transgluteal Posterior Column Screw Stabilization for Fractures of the Acetabulum

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INTRODUCTION: The traditional exposure of high posterior column acetabular fractures with extension into the angle of the greater sciatic notch can pose a challenge for achieving adequate fixation, particularly lag screw stabilization. Utilizing the Kocher-Langenbeck exposure, we describe and evaluate the results of an adjunctive percutaneous transgluteal lag screw technique for the internal fixation of the high posterior column. This technique has been helpful to achieve the optimal trajectory for a stable perpendicular lag screw to maintain an anatomic reduction. In our experience, this technique has been used in conjunction with posterior column plating techniques.

METHODS: From 2001-2010, 15 patients with acute acetabulum fractures in a series of 562 (2.7%) operatively-treated acetabulum fractures were managed with the transgluteal posterior column screw technique. All procedures were preformed utilizing a Kocher-Langenbeck approach in the lateral decubitus position. All fractures were managed with a transgluteal screw as the initial fixation compressing the fracture followed by neutralization with posterior column plating. Outcome and complications are reported. Radiographic outcome assessed reduction postoperative and at final follow up.

RESULTS: Anatomic reduction (<2 mm) was achieved in 13 (87%) and imperfect reduction (2-3 mm) in 2 (13%) patients. There were no iatrogenic sciatic nerve palsies. Follow-up averaged 25 months (2-89). Long-term radiographic evaluation was available for 10 primary internal fixation patients (7-excellent, 1-good, 2-poor). Of the 5 remaining: 1 died 2 weeks postoperative, 1 had an ipsilateral hemiarthroplasty, 1 fracture occurred adjacent to a primary THA, and 2 were lost to follow-up.

CONCLUSION: We conclude that high posterior column fractures extending into the sciatic notch are ideally fixated through the standard incisions combined with transgluteal screws. With careful exposure and protection of the sciatic nerve and superior gluteal vessels, this procedure has been without iatrogenic nerve or vessel injury. In our experience, the transgluteal screw has been convenient for achieving lag screw fixation of these fractures with excellent radiographic outcomes.

MAOA BREAKOUT SESSION #4
SPORTS
April 19, 2012

42. The Outcome of Partial Meniscectomy on Joint-Space Width: Data from the Osteoarthritis Initiative

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Anthony Miniaci, M.D.	Cleveland, OH

INTRODUCTION: While multiple studies have investigated the relationship between meniscectomy and joint space narrowing, none have compared patients undergoing arthroscopic meniscectomy with matched controls. We hypothesize that joint space width decreases more in patients who have meniscectomy than in matched controls over a one-year period in the OAI cohort.

METHODS: The Osteoarthritis Initiative (OAI) is a prospective cohort study sponsored by the NIH. The OAI follows 4,796 patients, ages 45-79, who are at risk for and presenting with osteoarthritis. This study was a retrospective cohort study on the data from the OAI. The Osteoarthritis Initiative cohort was queried for subjects who underwent meniscectomy after study enrollment. Subjects with surgery prior to enrollment or non-meniscectomy surgery during the follow-up period were excluded. Twenty-five meniscectomy patients were identified with MJSW measurements at both pre- and post-meniscectomy visits, and 75 controls were selected based on the above matching criteria. Baseline characteristics were analyzed with a two-sample, two-tailed t-test assuming equal variances.

RESULTS: Age, gender, BMI, and time interval between radiographs were not significantly different between meniscectomy and control groups. Minimum joint space width decreased significantly more (*$P < 0.01$) in patients who underwent meniscectomy than in controls.

DISCUSSION: Utilizing radiographic joint space measurements led us to the conclusion that meniscectomy leads to loss of joint space width much earlier than previously suggested. This may be due to the increased contact stress between the tibia and femur, damaging the articular cartilage in the knee joint, resulting in symptoms of osteoarthritis and joint space narrowing. However, this may also be the outcome of loss of the interposed meniscus, and thus not reflect true cartilage loss. Partial meniscectomy could also cause dysfunction in the remaining meniscus, possibly resulting in extrusion or flattening, which then manifests as joint space narrowing.

43. An Analysis of Time to Failure After ACL Reconstruction

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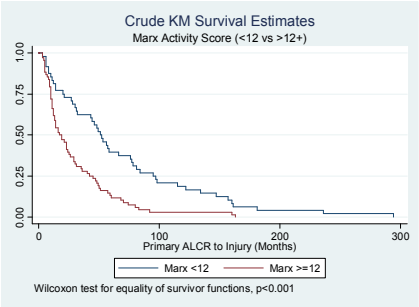
INTRODUCTION: Graft failure after ACL reconstruction (ACLR) can occur, and many recent studies have investigated the risk factors for graft failure. Very little has been reported regarding the time from ACLR to graft failure. This study's aims were: (1) determine the time to failure (TTF) after primary ACLR in a cohort of over 100 revision ACLRs using Kaplan Meier Survival Curve analysis and (2) identify factors which influence the Survival Curve.

METHODS: The charts where reviewed at three Multicenter ACL Revision Study (MARS) sites to determine the TTF. 116 patients met the criteria of having a clearly discernible TTF and complete prospectively collected demographic and intraoperative data. A Kaplan Meier Survival analysis was performed on the entire cohort and again looking for influence of activity, age, gender, meniscus tear, autograft/allograft, BMI, and hamstring (HS)/patella tendon (PT) graft choice on the TTF Survival Curve.

RESULTS: Results are displayed as survival graphs and reported as median TTF. Median TTF (mTTF) represents the time point at which 50% of the graft failures had occurred. The mTTF for the entire cohort was 22 months. Activity had the strongest influence on TTF. mTTF for high activity patients was 17 months compared to 51 for low activity patients. In highly active females, the mTTF was 12 months versus 25 in highly active males. High BMI patients had an mTTF of 42 months versus 16 for normal BMI patients. The TTF was not influenced by autograft versus allograft, HS versus PT grafts, or a lateral meniscus tear.

CONCLUSIONS: In ACLRs that had graft failure: returning to high activity, normal BMI and female gender were risk factors for shorter TTF. Graft type did not influence TTF.

Sample Kaplan Meier Survival Curve



44. Anterior Cruciate Ligament Reconstruction Tunnel Measurement Reliability with Fluoroscopy

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BACKGROUND: ACL reconstruction tunnel placement accuracy is often measured by postoperative radiographs. Several authors have proposed different measurements based upon plain films, yet there is a paucity of data reporting accuracy of these measurements. As a result, it is difficult to ascertain which measurements are the most applicable clinically. Our hypothesis is that when excellent radiographic views are obtained, the reliability of the measurements among experienced surgeons would be good to excellent.

METHODS: Tunnels for single bundle ACL reconstruction were drilled and filled with metal interference screws on 73 cadaver knees. Ideal fluoroscopic radiographs were obtained. Three independent reviewers performed 18 measurements including a modification of the grid method. For the grid method analysis, reviewers fit a 16 x 12 grid to the lateral knee radiograph and the center of the femoral tunnel was marked. Inter-observer reliability of the measurements was performed using intra-class correlation coefficients (ICCs). A precision grouping analysis was performed for the grid measurements to calculate the mean radius and standard deviation grouping distances.

RESULTS: The ICCs were excellent (>0.75) for the tibial tunnel angles on AP/lateral images, the AP/lateral tibia tunnel measurements, the clock face measurement, and the Aglietti and Jonsson measurements. ICCs were good (0.4-0.75) for an estimation of graft impingement, Harner's measurements, and notch height. The mean radius for grid measurements was 0.6 units (SD 0.4, range 0-2.36), with each unit being one box in the 16 x 12 grid. When a circle was constructed with a 1.3 unit radius, 95% of the three surgeons' measurements would be included in the area of that circle.

CONCLUSION: Reliability of ACL tunnel measurements was good to excellent under ideal circumstances for the majority of measurements. The modified grid method demonstrated very acceptable reliability.

45. Development of an Articular Cartilage Impact Injury Model in Rabbits

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OBJECTIVE: To develop and validate an impact cartilage injury model in rabbits to simulate injuries sustained in athletics or trauma that would lead to progressive cartilage deterioration.

METHODS: Seventy-seven skeletally mature adult New Zealand White rabbits underwent surgical exposure of the posterior medial femoral condyle. A pendulum impactor previously shown to deliver reproducible impacts across a range of impact levels with consistent rate was used to create impacts of 0 (control), 25, 35, 45, or 50 MPa to the weight-bearing surface of the condyle. Animals were killed and condyles harvested at 3, 6, and 12 weeks post-injury. The condyles were sectioned through the impacted area and stained with hematoxylin and eosin and safranin-O. All specimens were graded using the modified Mankin and ICRS scores. All samples were then rank-ordered from least to most damaged and analyzed using a rank correlation analysis.

RESULTS: There was a significant difference between all impact groups and the control group on histologic grading scores, as well as between the 0, 35, and 50 MPa groups. There was no significant difference between the 25 and 45 MPa groups and the other impact groups. With rank-ordering analysis, there was a statistically significant difference between all groups based on impact level and impulse energy of impact. Differences between different sacrifice times approached, but did not reach statistical significance, with the 50 MPa group showing the most worsening over time.

CONCLUSIONS: Reproducible cartilage injury that progresses over time can be created in the rabbit medial femoral condyle using a pendulum impactor with controlled impact pressure and consistent rate. These injuries simulate varying degrees of blunt impact damage to cartilage. The 50 MPa level showed the greatest progression of damage over time and, thus, should be used for future investigation of the long-term effect of such injuries as well as the efficacy of therapeutic interventions on the progression of cartilage damage.

46. Location Dependent Progression of Cartilage Lesions: An In Vivo Rat Model

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Articular cartilage lesions are common among symptomatic and asymptomatic knees and lead to breakdown of the focal chondral surface, surrounding cartilage, and subchondral bone. Due to dissimilar joint surfaces and biomechanical stresses, the degenerative process differs between medial and lateral femoral condylar lesions. Our study investigates possible differences in the degenerative process based on lesion location and the presence of loading. We randomly divided 20 rats into two groups of 10. Group 1 received 1 mm articular cartilage lesions in the weight-bearing portion of the right medial femoral condyle. Group 2 received 1 mm lesions on the right lateral femoral condyle. Five rats from each group exercised on a treadmill for 45 minutes for 41 consecutive days. The remaining rats were left in their cages. On day 42, rats were sacrificed and both knees dissected. Lesion progression was examined grossly using a high-resolution digital camera and microscopically using various stains. The extent of damage was scored in a blinded, randomized fashion by the research team using standardized methods. We found that due to the small sample size, no statistical significance was found between any group, as mixed results existed between gross and histological scoring groups. However, mean defect scores showed interesting patterns as gross scoring revealed unloaded lateral lesions to have a greater cartilage damage score compared to unloaded medial lesions while lateral loaded lesions had less damage compared to lateral unloaded lesions. Histologically, mean values showed unloaded medial lesions suffered less damage compared to unloaded lateral lesions, while loading protected against cartilage damage on medial, but not lateral lesions. While we cannot confidently assert that primary lesion location or the presence of loading significantly impacts the progression of cartilage damage, our results show we are trending towards statistical significance in both groups. Further work and larger sample sizes are necessary to examine these possible relationships as well as the development of secondary cartilage lesions and osteoarthritis before this data can be utilized in human models.

47. Clinical Outcomes and Rate of Redislocation Following Medial Patellofemoral Ligament Reconstruction

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INTRODUCTION: MPFL reconstruction for lateral patellofemoral instability is considered a biomechanically rational treatment and has been shown to have a low rate of redislocation. Several surgical techniques exist and each has acceptable outcomes with few complications. This study presents the early operative results and redislocation rate following a technique of MPFL reconstruction using soft tissue allograft with suture anchor fixation to the patella.

METHODS: MPFL reconstruction was performed in 22 consecutive patients and 24 knees. The average age at the time of surgery was 25.4 years (range 14-50). The number of reported dislocations prior to surgery was “less than 10” in 16 patients and “multiple” in 6 patients. The number of prior surgeries averaged 1.7 (range 0-5). Radiographic characteristics and arthroscopic findings, including the presence of chondromalacia, were recorded.

RESULTS: No immediate surgical complications were encountered. The average time to recovery was 5.1 months (range 2-9 months). At a minimum of one year postoperatively, there were no recurrent lateral patellar dislocations. Pain requiring treatment with narcotic pain medication at final follow-up was noted in two patients, and each patient had panpatellar arthrosis at the time of surgery. Late adverse events encountered included recurrent medial patellar subluxation requiring lateral retinacular repair (1), arthrofibrosis requiring manipulation under anesthesia (2), and medial femoral trochlear acute chondral lesions requiring loose body removal (2).

CONCLUSIONS: Anatomic reconstruction of the MPFL with soft tissue allograft and suture anchor fixation to the patella resulted in improved patellofemoral stability with a low rate of complication. Pain from patellar chondrosis may not be affected by improving the stability of the patellofemoral joint.

48. Anterior Cruciate Ligament Reconstructions in the U.S. Military: A Retrospective Case Series

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INTRODUCTION: The outcomes and rates of revision of ACL reconstruction (ACL-R) in the military population are not currently defined. Retrospective analysis was performed.

METHODS: The Military Health System Management and Analysis Tool was queried for all entries with CPT code 29888 between October 2002 and December 2010. Retrospective analysis was performed for all patients with multiple entries and a sample of patients with single entries utilizing the military electronic medical record system. Demographics at the time of the primary ACL-R, laterality, graft choice, and need for revision were recorded.

RESULTS: The initial query yielded 6,968 patients with 7,555 entries for the CPT code 29888, with 521 patients accounting for 1,108 entries. Retrospective review demonstrated an estimated 6,180 primary ACL-R performed in the military within the query period, with 372 patients requiring revision, yielding a revision rate of 6.02%. The proportion of good/excellent results following primary ACL-R increased with age at the time of index procedure (84.9% [greater than or equal to 30 years], 73.4% [26 to 30 years], and 71.9% [less than or equal to 25 years]) and female gender (90.5% vs. 76%). Males were more likely to be on active duty (92.6% vs. 76.2%) and to receive allograft (17.6% vs. 9.5%). Patients undergoing revision ACL-R, when compared to patients who did not undergo revision, demonstrated similar age (27±6.2 vs. 28±6.4 years) and duty status (92.6% vs. 90.9% active duty), a slightly higher proportion of females (15.3% vs. 10.7%), and more frequent use of allograft at primary ACL-R (24.7% vs. 20.0%).

DISCUSSION AND CONCLUSION: ACL-R in an active military population demonstrates similar rates of revision compared to civilian populations. Female gender and use of allograft correlate with higher rates of revision. Further investigation is required to elucidate the significance of this finding.

49. Outcomes of Repeat Revision ACL Reconstruction

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INTRODUCTION: A paucity of literature exists with respect to repeat revision anterior cruciate ligament (ACL) reconstruction surgery. The purpose of this study was to evaluate the clinical and functional outcomes of a group of patients who had undergone two revision ACL reconstructions.

METHODS: The records of all patients who had undergone repeat revision ACL reconstructions between 1991 and 2009 were retrospectively reviewed. Data collected included patient demographics, operative findings, pre- and postoperative physical examination details, imaging studies, and Tegner, Lysholm, and subjective International Knee Documentation Committee (IKDC) scores.

RESULTS: Fifteen patients had undergone repeat revision ACL reconstruction during the study period. Mean age was 27 years (18-57). There were eight males and seven females. Mean follow-up was five years (2-18). Reason for repeat revision ACL reconstruction included traumatic re-rupture in 9/15 (60%) patients, and recurrent instability without a definite traumatic event in 6/15 (40%). At the time of surgery for repeat revision, new tunnels were drilled in 9/15 (60%) cases. Of those, 8/9 (89%) were due to femoral tunnels being deemed “too anterior”. Prior to repeat revision, 11/15 (73%) patients were noted to have a meniscal tear, and 9/15 (67%) had International Cartilage Repair Society grade 3 or 4 chondral lesions. Mean Lysholm score was 60 preoperatively, and increased to 82 postoperatively ($p=0.003$). Mean preoperative IKDC score was 59, which increased to 80 postoperatively ($p=0.004$). Mean preoperative Tegner score was 6.0. Mean postoperative Tegner score was 4.5, with only 4/15 (27%) patients having returned to their prior activity level. Two patients (13%) re-ruptured. Presence of grade 3 or 4 chondral lesions and BMI >28 at the time of repeat revision were associated with a “fair” or “poor” outcome by Lysholm score ($p=0.007$ and $p=0.026$, respectively).

CONCLUSION: Repeat revision ACL reconstruction may improve the functional outcomes of patients who have failed revision ACL reconstruction. Most patients do not return to their prior activity level.

50. Effect of an Osteoarthritis Unloading Brace on Dynamic, In Vivo Tibiofemoral Joint Mechanics and Clinical Outcome

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BACKGROUND: Osteoarthritis (OA) of the knee is a common condition that is often treated non-operatively with knee braces. It is generally believed that knee braces unload the medial compartment, but the effect of knee braces on in vivo joint mechanics is not well understood. The objective of this study was to assess the effect of an OA unloading brace on dynamic, in vivo joint mechanics and clinical outcome.

METHODS: Ten patients with medial compartment knee OA were prescribed an OA unloading brace and allowed a two-week adaptation period. Dynamic biplane x-ray images of the knee were collected during treadmill walking both with and without the knee brace. 3D positions of the tibia and femur were measured from the biplane x-ray images using an accurate (±0.5°, ±0.5 mm) model-based tracking technique. Using these data, the functional joint space of the medial and lateral compartments was determined by calculating the minimum distance between the femur and tibia bone surfaces, averaged across the stance phase. In addition, the average joint contact center (i.e., average center of contact of the femur on the tibia during the stance phase) was determined for medial and lateral compartments. Clinical outcome was assessed using the WOMAC Index. The effects of the knee brace on biomechanical and clinical outcomes were assessed with a paired t-test.

RESULTS: Patients reported improved clinical outcomes with knee brace usage, as indicated by a 25.3% improvement in the WOMAC score ($p=0.01$). Despite improved clinical outcomes, the study failed to detect significant changes in the functional joint space of the medial ($p=0.26$) or lateral ($p=0.14$) compartments. Differences were also not detected in the anterior/posterior or medial/lateral location of the joint contact center for either the medial ($p>0.18$) or lateral ($p>0.16$) compartments.

DISCUSSION: Previous research has suggested the knee braces may alter muscle forces, gait patterns, and proprioception, but the current study failed to identify a biomechanical mechanism for improved clinical outcomes. Future research efforts will continue to explore the mechanism(s) associated with improved clinical outcomes.

51. Medical Expenditures on Division I Collegiate Athletes: Analysis by Sport and Gender

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INTRODUCTION: In order to better understand medical expenditures in collegiate athletics, the insurance claims of 36 teams at a single Division 1 athletic department were analyzed.

METHODS: The claims and charges data for all athletic related injuries/illness over a five-year period were obtained from the insurance coordinator for the athletic department. The data was analyzed for annual fluctuation and change over time. Sports were divided into corresponding male and female teams, female-only sports, male-only sports, and coed sports. Linear regression analysis was used to compare the corresponding male and female teams. Number of claims and total charges were analyzed by team/year and after normalizing for roster size, by athlete/year.

RESULTS: The team claims and charges were stable over the five-year timeframe. After normalizing for roster size in the gender matched sports, female athletes had .97 more average annual claims ($p<0.01$) and $1,459 higher annual charges ($p=0.001$) than their male counterparts. In 11 of the 14 gender-matched sports, the female athletes had higher average annual charges; also female athletes had a higher average number of annual claims in 13 of the 14 matched sports. The charges per claim were similar between the genders. The five teams with the highest average annual charges were: football, wrestling, softball, crew, and men's lacrosse. When normalized for roster size, the five sports with the highest average annual charges per athlete were: softball, women's diving, men's basketball, wrestling, and men's gymnastics.

SUMMARY: Charges per claim were similar between the matched gender sports, but the female athletes had a higher number of annual claims and, thus, higher total charges per athlete/year. Football had the highest average annual total charges, but when normalized for roster size, the charges per athlete/year were similar to many other sports. More research is needed into why gender differences in athletic medical expenses exist.

52. Pre-Season Physical Assessment and Screening in Amateur Overhead Athletes

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INTRODUCTION: Physical exam abnormalities may adversely affect performance and increase risk of injury. The purpose of this study was to determine the incidence of positive physical exam findings in pre-season, amateur overhead athletes, and to determine if differences exist across positions or sports.

METHODS: Two hundred and eighteen amateur baseball players (mean age 16.5 years, range 12-19 years); 67 starting pitchers, 97 relief pitchers, and 54 non-pitchers and 228 amateur volleyball players (mean age 14.9 years, range 9-18 years) were evaluated pre-season to identify potential at-risk elements for injuries to the upper extremity. Physical examination was performed by a fellowship-trained orthopedic surgeon. Assessment included core strength, rotator cuff strength, glenohumeral instability, and scapular mechanics.

RESULTS: Sixty-one baseball players (27.9%) and 51 volleyball players (22.4%) were identified with GIRD greater than 20°, whereas 46.3% of baseball players had rotator cuff strength deficits compared to 25% of volleyball players ($p<.01$). Relief pitchers demonstrated the highest prevalence of rotator cuff strength deficits when compared to starting pitchers and position players ($p=.036$). Examination revealed 56.4% of baseball players had evidence of scapular winging (91.7% with Type 1 or 2) compared to 43% of volleyball players (98.3% with Type 1 or 2), ($p<.01$). In contrast to baseball players, volleyball players demonstrated greater gluteus medius strength deficits (65.2% vs. 40.7%, $p<.01$) and considerable failure of the Mackenzie Core Strength Test (MCST) (92.4% vs. 50%, $p<.01$). When evaluating body mass index (BMI) as a predictive variable within baseball players, 100% of players with a BMI > 30 failed the Mackenzie Core Strength Test, and players with a BMI ≥ 26 failed at higher rate (71%) than those with a BMI < 26 (51.9%), ($p=.036$).

CONCLUSIONS: A significant number of asymptomatic preseason, amateur baseball, and volleyball players demonstrate abnormal physical examination findings. Institution of a pre-emptive rehabilitation program may permit improvement in performance and reduce the incidence of in-season injury.

MAOA BREAKOUT SESSION #5
REVISION ARTHROPLASTY
April 19, 2012

53. What are the Trends for Complex Joint Replacement Surgery?

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INTRODUCTION: The aim of this study was to describe trends for joint replacement surgery in the United States.

METHODS: Over 1.3 million joint replacement procedures, reported in the National Inpatient Sample were examined for years 2000-2008. Complex revision procedures were defined as those using a spacer or involving a joint infection or broken prosthetic (15,961, 9.3% of all revisions). Logistic regression was used to estimate patient, surgeon, and hospital factors associated with care of patients having revision or complex revision.

RESULTS: The number of revision knee cases per year doubled from 8,000 in 2000 to 16,000 in 2008, while the number of hip revision cases remained constant at about 7,500. The fraction of hip replacement patients receiving revision was slightly higher for those older than 75 (19% vs. 13%), but knee revision rates were highest in those younger than 50 (29 vs. 10%). Teaching hospitals performed 52% of revisions and 54% of complex revision procedures. The revision fractions were higher for Medicaid patients (19% vs. 12% other insurance) and low volume surgeons (16 vs. 11% mid or high). Patients younger than age 50 were more than twice as likely (odds ratio=2.12, 95% CI 2.09-2.15, $P<0.001$) than those age 51-75 to receive a revision and more than three times more likely to receive a complex revision (3.65, 3.58-3.73). Patients with Medicaid (1.52, 1.49-1.55), low volume physicians (1.53, 1.51-1.55), and teaching hospitals (1.36, 1.35-1.38) were also associated with a higher fraction of revision.

CONCLUSION: Type of insurance and surgeon volume were the biggest drivers for patient comorbidities.

54. A Nomogram to Predict Success of Single-Stage Irrigation and Debridement with Polyethylene Exchange

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INTRODUCTION: While the current gold standard for treatment of prosthetic joint infections (PJI) is a two-stage revision, single-stage irrigation and debridement with polyethylene exchange (PE) offers advantages such as fewer surgeries, reduced potential for intraoperative complications, and lower direct costs. Preoperatively predicting the probability that single-stage irrigation and debridement with PE will successfully eradicate a PJI may help identify appropriate patients for this procedure.

METHODS: Between January 1996 and October 2010, 10,411 revision total knee and total hip arthroplasties (TKA and THA) were performed at a single institution. Charts were reviewed to identify instances of PJI treated with a single-stage irrigation and debridement with PE. Data (demographic, microbiological, clinical presentation, perioperative, and medical comorbidity variables) and follow-up on 309 patients (n=247 TKA; n=62 THA) with PJIs treated with this procedure were collected. Average follow-up was 1,021 ± 59 days (range, 8 to 4,641). Univariate analysis was used to determine which variables were independently associated with failure to eradicate the PJI. Kaplan-Meier survival analyses were performed. Cox regression was used to construct a model predicting the probability of treatment success and used to generate a nomogram (R software, Vienna, Austria).

RESULTS: 149 (48.2%) cases experienced reinfection (n=122 TKA; n=27 THA) at an average of 240 days postoperative. Multiple variables independently associated with treatment failure included: longer duration of symptoms (p=0.001), higher ESR at presentation (p=0.02), previous joint infection or previous infection in the same joint (p=0.009), and an infection by either MRSA, MRSE, VRE, MSSA, or MSSE (p=0.005). Recurrence-free survival rate of patients symptomatic for ≥ 21 days or more was lower (p<0.0001) than patients who were symptomatic for < 21 days. Bootstrap corrected ROC for the nomogram was 0.645.

CONCLUSION: Determining the probability that this procedure will eradicate a PJI may improve patient selection and utilization of the single-stage procedure.

55. Organisms Differ at Time of Subsequent Surgery in Patients Previously Undergoing Irrigation and Debridement

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BACKGROUND: Salvage of infected primary total knee arthroplasty with irrigation, debridement, and liner exchange with antibiotic suppression is not always successful. The role of infecting organisms and their predictive value of successful irrigation, debridement, and liner exchange has been described. However, there is a paucity of literature examining whether the same organisms cultured at the time of irrigation, debridement, and liner exchange are also cultured at the time of surgery following failed suppression.

MATERIALS AND METHODS: From 1994 to 2010, we retrospectively reviewed 27 operations in 25 patients who underwent surgical treatment subsequent to failed irrigation, debridement, and liner exchange for infected primary total knee arthroplasty. All patients had cultures obtained at the time of both irrigation, debridement, and liner exchange and subsequent surgical intervention. The average age was 70 years, with 76% male patients and two bilateral knees.

RESULTS: The mean time from the index total knee arthroplasty to irrigation, debridement, and liner exchange was 44 months, with a mean interval to failure of 18 months. Eighty-one percent (22/27) of patients underwent resection of all components with placement of antibiotic spacer. Thirty percent (8/27) of knees had different organisms cultured at the time of subsequent surgical treatment than at the time of irrigation, debridement, and liner exchange. MSSA was cultured in 37% (10/27) of patients undergoing irrigation, debridement, and liner exchange whereas it was only cultured in 19% (5/27) of operations following failure of irrigation, debridement, and liner exchange. Coagulase-negative staphylococcus was the most frequently cultured organism found in 26% (7/27) of patients undergoing irrigation, debridement, and liner exchange and in 30% (8/27) of subsequent surgeries.

CONCLUSIONS: While cultures obtained at the time of irrigation, debridement, and liner exchange are helpful in directing suppressive antibiotic therapy, there is evidence to suggest that additional organisms play a role in the failure of this treatment modality.

56. Extensor Mechanism Allograft Reconstruction for Extensor Mechanism Disruption Following Total Knee Arthroplasty

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Richard A. Berger, M.D.	Chicago, IL
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INTRODUCTION: Extensor mechanism disruption following total knee arthroplasty (TKA) is a devastating complication. The most appropriate method for repair remains controversial. The purpose of this study is to report our experience with extensor mechanism allograft (EMA) reconstruction for chronic extensor mechanism disruption.

METHODS: We performed 64 consecutive EMA in 41 women and 15 men who had a mean age of 67.6 years old at the time of surgery (range, 41-87) and followed for a minimum of two years or until failure. Five were revision EMAs, five were performed as part of a two-stage exchange, one patient was lost to follow-up, and three patients died leaving 50 reconstructions. The grafts were tensioned tightly in full extension and then immobilized for six weeks followed by gradual range of motion. Failure was defined as a KSS Knee Score < 60, extensor lag > 30°, or further revision surgery.

RESULTS: At a mean of 57.6 months (range, 24-125), the mean KSS improved from 33.9 to 75.9 points (range, 8-100; $p < .0001$). Twenty-eight patients had full active extension (56%). Complications included six revisions of the tibial bone block fixation (12%), five of which healed and three periprosthetic fractures of the tibia at the site of the tibial bone block. Nineteen patients were considered failures (38%) including four revised to a second EMA due to recurrent lag and instability, five deep infections, and ten patients who had a knee score of < 60 points and/or an extensor lag > 30°. Survivorship with failure for any reason as the endpoint was 62% at two years.

CONCLUSION: Extensor mechanism allografts can be effective for patients with extensor mechanism disruption. However, based on our results, patients' expectations must be tempered by the high rate of complications and failure.

57. A Nomogram to Predict Success of Two-Stage Revisions for Treating Knee Prosthetic Joint Infections

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INTRODUCTION: Two-stage revision, with the interim placement of an antibiotic-laden cement spacer, is considered the gold standard for treatment of knee prosthetic joint infections (PJI). Guidelines for selecting the most appropriate procedure to eradicate a knee PJI are based upon the duration of symptoms, condition of the implant and soft tissue and, if known, infecting organism. A tool to identify patients at high risk for treatment failure may improve preoperative risk assessment, resulting in closer monitoring and more aggressive management.

METHODS: Between January 1996 and October 2010, 10,411 revision total joint arthroplasties were performed at a single institution. Charts were reviewed to identify instances of knee PJI treated with a two-stage revision. Data (microbiological, clinical presentation, preoperative and medical comorbidity variables) and disease follow-up on 314 patients with infected total knee arthroplasties treated with two-stage revision were collected. Univariate analysis was used to determine variables associated with failure to eradicate the PJI. Cox regression was used to construct a model predicting the probability of treatment failure and used to generate a nomogram. Internal validation was done with bootstrapping.

RESULTS: 209 (66.6%) cases experienced reinfection at an average of 429 days (range: 9-3,886) following the two-stage revision. Univariate analysis identified multiple variables independently associated with reinfection including: a longer duration of symptoms ($p<0.001$), a longer time from the index total knee arthroplasty ($p=0.003$), a higher number of previous surgeries in the same joint ($p<0.001$), an elevated C-reactive protein ($p=0.005$), an elevated erythrocyte sedimentation rate ($p=0.006$), a low hemoglobin ($p=0.001$), a previous infection in the same joint ($p<0.001$), diabetes ($p<0.001$), and heart disease ($p=0.006$). Bootstrap corrected receiver operating characteristic for the nomogram was 0.77.

CONCLUSION: This nomogram may be a useful tool for preoperative risk assessment of patients with presumed knee PJIs, helping physicians better manage and treat these individuals.

58. Value of Inflammatory Markers for Success of Irrigation and Debridement in Acute Hematogenous Total Knee Infections

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BACKGROUND: Irrigation and debridement with liner exchange is an accepted treatment for acute hematogenous infections. The role of C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) have been well established in the diagnosis of acute total knee infections. However, the value of ESR and CRP in predicting successful outcomes in patients treated with irrigation, debridement, and liner exchange is unknown.

MATERIALS AND METHODS: We retrospectively reviewed 88 total knee infections in 82 patients treated with irrigation, debridement, and liner exchange from 1995 to 2010 at a single academic, tertiary care center. All patients included had WBC, ESR, and CRP values assessed within 48 hours of surgery. The average age was 72 years, with 61% male patients and five bilateral knees. The mean follow-up was 42 months.

RESULTS: The mean time from the index surgical intervention to irrigation, debridement, and liner exchange was 60 months. The average operative and anesthesia times were 123 and 200 minutes, respectively. On final cultures, the most common organism was MSSA. Twenty-three percent (20/88) of knees failed irrigation, debridement, and liner exchange, with 17 requiring two-stage reimplantation. The average preoperative WBC count in those who were successfully treated with irrigation, debridement, and liner exchange was 12, compared to 11 in those patients who failed (p=0.3). Likewise, there was no difference in ESR between those who were treated successfully, as opposed to those who failed (60 vs. 61, respectively; p=0.9). Finally, we found that those effectively treated with irrigation, debridement, and liner exchange had a CRP of 171, as opposed to 159 in those who failed (p=0.9).

CONCLUSIONS: In the largest series to date, there was a 23% failure rate with irrigation, debridement, and liner exchange for acute hematogenous total knee infections. While inflammatory markers are useful in diagnosing total knee infections, there is no predictive value of WBC, ESR, or CRP counts in regards to the success of future surgical intervention.

59. Risk Factors for Dislocation Following Revision Total Hip Arthroplasty

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INTRODUCTION: Despite dislocation being the most frequent complication following revision total hip arthroplasty (THA), risk factors for its occurrence are not completely understood. The purpose of this study was to examine patient and surgical risk factors for dislocation following revision THA.

METHODS: We performed 1,212 revision THAs between June 2004 and October 2010 in 610 women and 518 men who had a mean age of 64.7 (range, 22-95) at time of surgery and were followed for a minimum of 90 days or until dislocation. One hundred five patients were lost to follow-up and 12 died, leaving 1,095 hips followed for a mean of 2.0 years (range, 90 days to 6.6 years). Multivariate logistic regression was performed to identify risk factors for dislocation.

RESULTS: Fifty-five patients dislocated within 90 days (5.0%) and 101 dislocated over the entire period of follow up (9.2%). Factors which were significantly different between patients who did and did not dislocate included patient age (62.5 vs. 64.9; p=.03), cup size (58.0 vs. 59.4 mm; p=.05), head/cup ratio (1.71 vs. 1.65; p=.02), head size (34.3 vs. 36 mm; p=.0002), number of previous revisions (1.9 vs. 1.6; p=.0014), type of revision procedure (p=.0063), female sex (p=.0155), revision specifically for instability (44.6% vs. 25%; p<.0001), and abductor deficiency (17% vs. 5.9%; p < .0001). Multivariate logistic regression identified younger age (p=.03), female sex (p=.01), abductor deficiency (p=.0138), and history of instability (p=.0044) as factors predictive of dislocation.

CONCLUSIONS: Dislocation remains a common problem following revision hip surgery with over half of them occurring within the first 90 days. Recognition of these risk factors is important for the surgeon performing revision THA.

60. Revision of Failed Salvage Acetabular Reconstruction with a Custom Flanged Component

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Massive acetabular defects present a reconstructive challenge and, unfortunately, many attempted reconstructions of these complex defects do not prove stable in the long or even short-term. The problem of what reconstructive option to use after failure of so-called “salvage” procedures is a difficult one. This paper presents results in ten patients revised with a custom, flanged acetabular component after failure of previous salvage reconstruction, including failed anti-protrusio cages, previous custom cups, and porous metal augment reconstruction.

MATERIALS AND METHODS: Ten acetabular reconstructions with a Triflange cup, all done for failure of previous salvage reconstruction, were retrospectively reviewed. Harris hip scores and sequential radiographs were used to evaluate clinical and radiographic results. The titanium prosthesis was custom-manufactured based on a three-dimensional model of the hemipelvis created from CT-scan data. The back surface of the component in all cases was both porous- and hydroxyapatite-coated, and initial stability was with screw fixation.

RESULTS: All custom components matched the anticipated patient anatomy found at the time of surgery and were felt to fit nicely the complex defects that existed at the time of reconstruction. At mean follow-up of 4.5 years (range, 2-8 years), no component showed radiographic evidence of loosening, migration, or broken screws. Harris hip scores improved postoperatively as compared with preoperatively, but most patients continued to require ambulatory aids. No component has been removed or is pending revision.

DISCUSSION/CONCLUSION: The Triflange cup is a durable solution to even the most catastrophic cases of bone loss in failed total hip arthroplasty. The alternative methods of reconstruction of these large defects, namely use of porous metal augments and anti-protrusio cage constructs, are doomed to failure because they do not meet the criteria needed for success in any revision, namely the stable intimate fixation of metal strong enough to withstand anticipated loads against host bone.

61. The Use of Abduction Bracing for Early Postoperative Dislocation Prevention Following Revision Hip Arthroplasty

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INTRODUCTION: One potential strategy to decrease the risk of dislocation following revision total hip arthroplasty (THA) is the use of an abduction brace to limit flexion and adduction. Despite the common use of this strategy, we are unaware of prior studies that have examined its efficacy. The purpose of this study was to examine the dislocation rate of patients who were braced versus those who were not following revision THR.

METHODS: We performed 1,212 revision THA between June 2004 and October 2010 in 610 women and 518 men who had a mean age of 64.7 (range, 22-95) and were followed for a minimum of 90 days or until dislocation. One hundred five patients were lost and 12 died, leaving 1,095 hips followed for a mean of 2.0 years (range, 90 days to 6.6 years). Four hundred seventy were treated with an abduction orthosis for six weeks while 625 were not. Multivariate logistic regression was performed to control for confounding variables.

RESULTS: The 90-day dislocation rates among patients who wore a brace was 4.7% compared to 5.9% in the non-brace group; with the numbers available for study, this difference was not significant (p=.42). At final follow-up, the dislocation rates were 11.1% in the brace group and 9.6% in the non-brace group (p=.48). There was a trend in the brace group for patients being revised specifically for instability (18.9% vs. 15.8%; p=.20). Multivariate regression found no benefit to bracing (p=.26) while controlling for age, sex, BMI, number of revisions, head size, deficient abductors, and history of instability.

CONCLUSIONS: Dislocation remains a common complication following revision THR. However, our data do not support the routine use of abduction orthoses to aid in the prevention of this complication.

62. Long-Term Clinical and Radiographic Outcomes with a HA-Coated Femoral Component in Revision THA

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INTRODUCTION: Little is known about the long-term outcome of hydroxyapatite (HA) coated implants in revision total hip arthroplasty (THA). In the often proximally deficient femur encountered at revision, achieving and maintaining fixation is critical, and concerns remain that the HA coating disappears, threatening stability. The purpose of this paper is to report the minimum ten-year results with a HA-coated femoral component in revision THA.

METHODS: Forty-six patients (47 hips) underwent cementless revision THA with a custom-designed, titanium, proximally and circumferentially HA-coated femoral component with a grooved surface at the coating to enhance mechanical interlock. The grooved surface was not circumferential. Femoral strut allografts were utilized in four cases. Eighteen patients died prior to achieving minimal follow-up of ten years, and four were lost, leaving 25 hips with a mean follow-up of 14.5 years (range, 10-18 years). Clinical and radiographic outcomes were reviewed.

RESULTS: At latest follow-up, 22 of 25 hips remain in place and have Harris hip scores rated as excellent (17 hips) or good (12 hips). Radiographic review demonstrated all stems showed evidence of osseointegration at long-term. No stem was re-revised for mechanical loosening. One femoral component was re-revised early for recurrent infection. One hip was re-revised at 16 years for a periprosthetic fracture distal to the tip of a well-fixed stem, and an additional well-fixed stem was re-revised at 15 years at the time of acetabular revision because retention of the stem would have resulted in over-lengthening of the leg with the correction of the hip center of rotation. Osteolysis was present in nine (41%) hips, limited to Gruen zones 1 and 7 in 7, distal to the coating in two hips.

DISCUSSION AND CONCLUSION: HA-coated custom stems in revision THA demonstrate excellent results at long-term, with stable fixation rates comparable to those seen in primary THA. The fixation stability does not appear to diminish over time.

63. Mid-Term Results of Conversion UKA to TKA

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OBJECTIVE: The number of unicompartmental arthroplasties performed in the U.S. has grown significantly in the last few years. As the number of UKA grows, so will the number of failures. A better understanding of the reasons for failure and outcomes after conversion to TKA is warranted. The objective of this study is to report the outcomes of modern UKA revised to TKA in four U.S. centers.

METHODS: A review of all UKA converted to TKA in four centers was performed. 109 conversions in 103 patients (61 males, 42 females; average age of 64 years) were performed from 1995 to 2011. Individual joint registries and chart reviews were performed to collect data regarding reasons for revision, type of implants used, and re-revision rates.

RESULTS: The average time to conversion to TKA from index UKA was 70 months (range 2-240 months). The four most common reasons for failure of the UKA was progressive arthritis of the lateral or patellofemoral joints (39%, 45/114), tibial failure/loosening (24%, 28/114), femoral failure/loosening (13%, 15/114), and infection (10%, 11/114). Seven of 109 knees (6.4%) were subsequently revised at an average of 49 months (range 7-123 months). The reasons for re-revision included: loosening of the femoral or tibial components in five and infection and arthrofibrosis in one each.

CONCLUSIONS: The re-revision rate after conversion TKA from UKA was 6.4% at an average of 65 months (5.4 years). Survivorship of a converted UKA to TKA is comparable to many series of primary TKA with acceptable mid-term results.

MAOA SECOND PLENARY SESSION
April 20, 2012

64. The Association of Socioeconomic Factors with Surgical Site Infection Following THA

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INTRODUCTION: Several co-morbidities including diabetes and rheumatoid arthritis (RA) are associated with an increased risk of surgical site infection (SSI) following THA, but the influence of socioeconomic factors such as race and household income on SSI is not fully understood.

MATERIALS AND METHODS: We conducted a five-year retrospective cohort study of hip arthroplasty patients using administrative records at a 1,250 bed, teaching hospital. SSI cases were defined using National Healthcare Safety Network (NHSN) surveillance criteria.

RESULTS: 3,490 procedures were identified between July 2005 and July 2010. 1,646 (47.2%) of patients were male, 439 (12.6%) were African-American, 1,126 (32.3%) had body mass index (BMI) ≥ 30 kg/m^2 (median BMI=27.9, [range 10.1-62.4]), 359 (10.3%) had diabetes, 113 (3.2%) had RA and median age = 58 years (range 13-102). 632 (18.1%) were revision cases; 38 (1.1%) patients developed SSI. A nested case-control study compared 38 SSI cases to 114 randomly selected controls. Univariate risk factors for SSI included revision surgery (12 [31.6%] cases vs. 16 [14.0%] controls, P=.018) and a patient home zip code in the lowest quartile of median household income (16 [42.1%] vs. 22 [19.3%], P=0.028). In a multivariate logistic regression model, African-American race was significantly associated with SSI (21.1% of cases vs. 8.8% of controls; adjusted odds ratio = 5.8; 95% confidence interval, 1.7-19.5) after adjusting for RA, ASA score, and surgery duration.

CONCLUSION: Both socioeconomic and patient factors significantly impact the incidence of SSI following THA, and both should be considered in risk adjusting THA SSI rates between centers.

65. The Role of Eccentric and Offset Humeral Head Variations in Total Shoulder Arthroplasty

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INTRODUCTION: Offset and eccentric head shape variations in total shoulder arthroplasty (TSA) were developed based on purported biomechanical advantages. The study seeks to determine if these design modifications and expanded prosthesis variety have led to better long-term outcomes in TSA.

METHODS: 187 primary third generation TSAs in 170 patients with osteoarthritis were retrospectively reviewed. Patients received either a standard, eccentric, or offset head, and an all-poly pegged glenoid component. All TSAs were performed by one of our two senior authors between 2001 and 2005 and had at least two years of follow-up. Outcome measures included pre- and postoperative pain and range of motion, and postoperative modified Neer scores. Survivorship, free from revision for any cause, was assessed using a Kaplan-Meier survival analysis.

RESULTS: Eighty-six shoulders in females and 101 shoulders in males, with a median patient age of 69, underwent TSA. Fifty-seven standard, 66 eccentric, and 64 offset heads were used. The mean follow-up was 61 months. Pain scores decreased by an average of 2.7 points on a 5 point scale ($p<0.001$) without a difference between third generation designs ($p=0.33$). Abduction and external rotation increased by an average of 59° and 35° ($p<0.001$), respectively, without a difference between third generation designs ($p=0.73$ and 0.62). When compared to standard heads, eccentric and offset heads provided no advantage in survivorship ($p=0.28$ and 0.57). There were a total of 103 excellent, 51 satisfactory, and 29 unsatisfactory results based on modified Neer scores. No differences were noted in modified Neer score distribution between the three head types ($p=0.28$).

DISCUSSION: Evolution of total shoulder designs has provided orthopedic surgeons with options to more accurately re-create the patient's individual anatomy. These advancements have resulted in increased implant cost, with a clinical performance and survivorship equal to, but not greater than, standard heads.

66. Minimum 20-Year Follow-Up of a Cruciate Retaining Modular TKR with Cement: What We Can and What We Can't Learn from Long-Term Follow-Up Studies

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INTRODUCTION: Modular tray TKR designs are the most commonly used designs in total knee arthroplasty today. To our knowledge, there are no studies evaluating the minimum 20-year results using these designs. The purpose of this study was to evaluate the minimum 20-year results of total knee arthroplasty using a modular tibial tray cruciate-retaining total knee arthroplasty design.

MATERIALS AND METHODS: The first 101 posterior cruciate retaining modular tibial components of a single design performed by a single surgeon in 75 patients were evaluated at a minimum 20-year follow-up. All components were fixed with cement. These patients had been prospectively followed at five-year intervals and evaluated clinically using Knee Society ratings and documenting any need for reoperation. Serial radiographs were evaluated for radiolucencies, osteolysis, and component migration until the time of patient death or at minimum 20-year follow-up.

RESULTS: At minimum 20-year follow-up, five knees (5%) had required a revision operation. All revisions occurred greater than ten years following the index procedures. Benefits of modularity (i.e., retention of the tibial tray) were utilized in three of five cases in this closely followed cohort. Survivorship from any revision was 90.8% at 20 years. For the 16 living patients with 22 knees, the average Knee Society Clinical and Functional scores were 91 and 59, respectively, and the average range of motion was 115°. Osteolysis occurred around ten knees (10%) during the follow-up interval.

CONCLUSIONS: When considering gamma irradiated in air polyethylene and a first generation locking mechanism were utilized, these results encourage the authors to continue to use modular tibial trays.

67. Pediatric Supracondylar Humerus Fractures: A Technique to Aid in Closed Reduction

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Dr. Herzog is the recipient of the Edward D. Henderson, M.D., Physician in Training Award.

PURPOSE: Pediatric supracondylar humerus fractures (PSCHFs) are the most common fracture of the pediatric elbow. The purpose of this study was to compare surgical treatment methods of pediatric supracondylar humerus fractures.

METHODS: From 2002 through 2010, 145 displaced PSCHFs were treated operatively at a level 1 trauma center by a single fellowship-trained orthopedic trauma surgeon and retrospectively identified. In Group 1, fractures failing successful reduction via closed manipulation underwent formal open reduction. In Group 2, fractures irreducible via simple closed reduction underwent a new technique involving percutaneous Shantz pin placement in the humeral shaft to assist in fracture reduction.

RESULTS: A total of 145 PSCHFs were retrospectively identified. Group 1 had 91 fractures (33 type II and 58 type III), and Group 2 had 54 fractures (15 type II and 39 type III). There were two open fractures, one in each group. Significantly less type III fractures in Group 2 compared to Group 1 required open reduction ($p=0.025$), with 11 of 58 (17.2%) type III fractures in Group 1 and 1 of 39 (2.6%) type III fractures in Group 2. Ten of the 39 (25.6%) type III fractures in Group 2 utilized the Shantz pin technique, and all of these achieved anatomic reduction. No fracture treated with the Shantz pin reduction technique required open reduction. The average operative time for Group 1 fractures treated with open reduction was 32.7 minutes; whereas the average operative time for Group 2 fractures treated with the Shantz pin technique was 22.0 minutes ($t=2.417$, $sig=0.029$). There were two superficial pin infections, both in Group 1. No significant difference was found between Groups 1 and 2 for fracture reduction (as determined on AP and lateral radiographs) or complications. No radial nerve palsies occurred with the use of the Shantz pin technique.

CONCLUSION: The use of a posteriorly placed Shantz pin aids in timely anatomic reduction and decreases the need for open treatment of displaced PSCHFs, without compromising final reduction or complication rates.

68. Cementless THA in Patients Age 50 and Under at Minimum 10-Year Follow-Up: What Can Be Learned Concerning Durability of the Construct?

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INTRODUCTION: The durability of total hip arthroplasty in the younger patient has been reported to be less than in the older population. Unfortunately, there are very few published series of cementless total hip arthroplasties in patients 50 and under at the time of surgery who are followed for at least 10 years. The purpose of this study was to evaluate the results of cementless total hip replacement performed in a consecutive series of patients age 50 and under who are followed for a minimum of 10 years.

METHODS: We prospectively followed 100 consecutive patients (115 hips) age 50 and younger at the time of surgery who were treated with primary cementless total hip arthroplasty using a second generation extensively porous coated femoral stem and a cementless acetabular component. The average age at surgery was 40.1 years. Sixty-eight patients (78 hips) were followed for a minimum of 10 years (mean 12 years, range 10-15.7 years). There were only five patients who were lost to follow-up. Hips were evaluated clinically for revision and by SF-36, WOMAC, Tegner, and UCLA questionnaires. Radiographs were evaluated for wear, loosening, and osteolysis.

RESULTS: At minimum 10-year-old follow-up, two stems were revised for periprosthetic fracture, and no stems were revised for loosening. All stems demonstrated bony ingrowth at 10-year follow-up. No shell was revised for loosening and none were demonstrated to be radiographically loose at minimum 10-year follow-up. Twelve acetabular liners (10%) were revised for wear. Activity as measured with a pedometer correlated with increase in wear ($p=0.0002$).

DISCUSSION: Cementless total hip arthroplasty using a second generation extensively porous coated stem demonstrated durable fixation in a younger population at minimum 10 years. Bearing surface wear was the long-term problem. This is the population where differences in bearing surface wear should be studied to determine if there are long-term differences in durability.

69. Clearing the C-Spine in Obtunded Trauma Patients Based on Admission CT: A Prospective Randomized Trial

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INTRODUCTION: Cervical spine clearance in the obtunded trauma patient with a normal CT is highly debated and lacks standardization. This results in disjointed management of c-collar precautions and prolongs unnecessary immobilization. C-collars are associated with respiratory deterioration, skin breakdown, and venous thrombosis. We prospectively analyzed two c-spine clearance protocols at a level 1 trauma center. Early radiographic clearance at 48-72 hours based on admission cervical CT versus c-collar immobilization until clinical examination. We hypothesize that c-spines in obtunded patients can be safely cleared with cervical CT alone.

METHODS: Ninety-six obtunded trauma patients were admitted to our facility with cervical CT scans negative for injury. Exclusions included c-spine fracture and abnormal spinal cord exam. One spine surgeon cleared the c-spine using cervical CT. Two spine surgeons awaited patient participation in a clinical examination prior to clearance. Randomization was based on the spine surgeon on call. The White and Panjabi stability scale and the cervical spine injury severity score determined radiographic stability. All patients cleared using CT alone underwent clinical exam once alert.

RESULTS: Forty-one patients underwent c-spine clearance radiographically at a mean of 4 days (2-14 days). Fifty-five patients remained immobilized until clinical exam was performed at an average of 15 days (2-44 days). Radiographic clearance decreased immobilization by 11 days ($p<0.001$). There was no difference in age ($p=0.7$), admission GCS ($p=0.9$), or hospital days ($p=0.8$). Documented c-spine exam was available for all patients cleared radiographically when alert. No patients had missed injury.

CONCLUSION: Removal of c-spine precautions based on a negative CT scan at admission is a viable option in trauma patients anticipated to remain obtunded for a significant amount of time. We were able to safely decrease the duration of unnecessary immobilization by 11 days. There were zero missed injuries that resulted in clinical instability.

70. Genetic Engineering of Juvenile Human Chondrocytes Improves Scaffold-Free Mosaic Neocartilage Grafts

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INTRODUCTION: Current articular cartilage restoration modalities have drawbacks such as donor-site morbidity, two-stage surgery, and fibrocartilaginous repair. We sought to evaluate the effects of genetic engineering and differentiation medium on scaffold-free neocartilage formation in-vitro to develop a superior off-the-shelf graft using juvenile human chondrocytes (jCh).

METHODS: Articular cartilage was harvested from individuals (< 7 years old) undergoing routine amputation. jCh were isolated, expanded, and transduced with adenoviral vectors for bone morphogenetic protein-2 (AdBMP2). jCh were suspended, centrifuged, and grown for two weeks to form neocartilage. For part-1, treatment conditions compared transduction versus no transduction (naïve) and standard media versus chondrogenic differentiation media (CDM). For part two, the ratio of transduced to non-transduced jCh was varied (0:100%, 10:90%, 25:75%, 50:50%, 75:25%, 100:0%) to form neocartilage.

RESULTS: In standard media, AdBMP2-transduced jCh resulted in larger diameter, increased mass, and histologically superior ($p \leq 0.0035$) neocartilage than naïve jCh. Compared to standard media, CDM improved diameter, weight, histology, and collagen type-II expression ($p \leq 0.0081$) regardless of transduction. With CDM, transduction of 10%, 25%, or 50% of jCh with AdBMP2 produced superior weight, histology, and collagen type-II expression compared to naïve jCh and 75% or 100%-transduced jCh ($p \leq 0.044$). Soluble BMP2 production tended to increase with greater proportions of AdBMP2-transduced jCh ($p \geq 0.03$). Chondrocyte viability was reduced in neocartilage with $\geq$ 50% proportion of transduced jCh ($p \leq 0.035$).

DISCUSSION: We demonstrated that low proportions of transduction were superior to high levels or no transduction and that jCh grown in CDM and genetically engineered to express elevated soluble BMP2 produced potential neocartilage grafts after a short incubation period. In vivo testing of this concept is currently underway using a rat model.

MAOA BREAKOUT SESSION #6
HIP PRESERVATION
April 20, 2012

71. Does the Hip Joint Need to be Opened at the Time of Periacetabular Osteotomy (PAO)?

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INTRODUCTION: Performing an arthrotomy to assess the labrum or impingement during a PAO is controversial. An arthrotomy could add morbidity to the procedure and delay rehabilitation. The objective of this study is to describe the findings of selective arthrotomy at the time of PAO, with attention to pain relief and need for subsequent surgery.

METHODS: 373 PAO were performed on 333 patients between 1996 and 2009. Arthrotomy was performed if the patient had mechanical symptoms, radiographic evidence of labral pathology, or a femoral head neck junction osteochondroplasty was required. The labrum was pathologic if it required debridement or repair. Clinical notes were reviewed for recurrence of symptoms or need for subsequent surgery.

RESULTS: 268 hips (70%) underwent an arthrotomy at the time of PAO. Labral pathology was found in 108 of these hips (40.2%). 105 hips required debridement only, and 3 had complete labral detachment requiring suture repair. 19 hips underwent femoral head neck junction osteochondroplasty with 10 of these having evidence of labral pathology. Only one patient that underwent arthrotomy had a subsequent surgery at eight years. One patient in the group that did not undergo arthrotomy had subsequent surgery for labral pathology at three years.

CONCLUSIONS: The recurrence of symptomatic labral pathology was extremely low in this group of patients undergoing PAO. The arthrotomy detected labral pathology in 40% of the hips that had preoperative mechanical symptoms or evidence of labral pathology on MRI. Using these criteria, only one hip that did not undergo arthrotomy required subsequent surgery. An arthrotomy is not necessary if these criteria are not met. Currently, arthroscopy could be used as an adjunct of PAO in cases where labral pathology is present if an arthrotomy is not performed.

72. Comprehensive Surgical Treatment of Residual Perthes-Like Hip Deformities

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INTRODUCTION: Residual Perthes-like hip deformities are extremely challenging to treat and encompass varying degrees of femoroacetabular impingement (FAI), secondary acetabular dysplasia (with instability), and osteochondral/acetabular labral lesions. There is a lack of consensus regarding a systematic approach to the surgical treatment of this wide disease spectrum. The purpose is to review the characteristics of residual Perthes deformities, and outline our current surgical treatment strategies for residual, symptomatic deformities.

METHODS: The senior author's hip surgery database of 4,007 cases was queried for all patients with residual Perthes deformities of the hip. 121 cases were identified and were analyzed for this report. The cases were divided into three categories including (1) FAI, (2) FAI and instability, and (3) major joint incongruity and/or secondary osteoarthritis. Patients were divided into these different groups for treatment decision-making. Basic patient demographics, surgical procedure profile, and early clinical outcomes were evaluated.

RESULTS: 40.7% of patients were female, and the average age at surgery was 25.4. 34.7% of patients were classified as femoroacetabular impingement, 34.7% were classified as combined FAI and structural instability, and 29.8% were classified as major incongruity or secondary osteoarthritis. Cases classified as FAI were primarily treated with surgical dislocation of the hip. Those classified as combined FAI and instability were treated with periacetabular osteotomy and combined surgical dislocation and/or proximal femoral osteotomy. Hips with end-stage or major incongruity were treated with total hip arthroplasty. Early clinical results of these patient cohorts were obtained at a mean of 31.4 months. Harris hip scores improved from 60 to 81.9, 59 to 82.8, and 53 to 84.1 for the respective groups.

CONCLUSION: Residual Perthes deformities of the hip present challenging reconstructive problems. An algorithmic approach combining impingement procedures, instability procedures, and total hip arthroplasty is necessary for comprehensive surgical treatment. Early clinical results with this algorithm approach demonstrate good clinical results for most.

73. Surgical Hip Dislocation for Failed Arthroscopic Management of Femoroacetabular Impingement

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INTRODUCTION: Not all deformities associated with femoroacetabular impingement (FAI) can be treated arthroscopically. We report on a select group of patients who underwent surgical hip dislocation (SHD) for treatment of persistent FAI after hip arthroscopy with emphasis on reporting the reasons for failure of the hip arthroscopy.

METHODS: Twenty-three patients (25 hips) who had undergone hip arthroscopy prior to SHD were identified from 155 patients (178 hips) treated with SHD between August 2002 and February 2011. The average age was 28.4 years (18-50). The average follow-up was 18 months (2-54). The average time between arthroscopy and SHD was 1.5 years (0.5-4). Clinical notes, radiographs, and operative notes were reviewed.

RESULTS: The primary mode of failure of arthroscopy was identified as a persistent offset abnormality in 12 hips, persistent acetabular overcoverage in 10 hips (6 anterior/superior and 4 global), femoral head articular cartilage damage in 2 hips, and 1 hip had a shortened lateral neck. At last follow-up, 18 of 25 hips had pain relief while 7 continued to have significant symptoms. Two hips underwent subsequent total hip arthroplasty and two underwent hip arthroscopy.

CONCLUSION: Undercorrection of the structural abnormality at the time of arthroscopy was identified as the primary mode of failure in 23 of 25 hips. It is unlikely that the structural abnormality in the four hips with global acetabular overcoverage and the one hip with a shortened lateral neck could have been adequately addressed arthroscopically. It is unclear if the 12 hips with persistent offset abnormalities and the 6 hips with persistent anterior/superior overcoverage could have been adequately treated with a more thorough correction at the time of arthroscopy.

74. The Prevalence of Pincer-Type Morphologies in Symptomatic Femoroacetabular Impingement

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INTRODUCTION: Femoroacetabular impingement (FAI) most commonly occurs with combined features of cam-type and pincer-type morphologies. We categorized pincer-type morphology into three distinct patterns (focal anterosuperior overcoverage, true hemipelvis retroversion, global overcoverage) and investigated the prevalence of each of the types of pincer-type morphology.

METHODS: The AP pelvis radiographs of 55 consecutive patients treated for FAI were analyzed by four readers for radiographic parameters of pincer-type FAI. Forty-six patients were analyzed by four readers for a total of 184 hips analyzed. Radiographic parameters of pincer-type FAI included the crossover sign (COS), prominent ischial spine sign (PRIS), posterior wall sign (PWS), lateral center edge angle (LCEA), and acetabular inclination (AI).

RESULTS: Pincer-type morphology was present in 57.6% of symptomatic FAI hips (106/184). A COS was present in 38.6% (71/184) of hips. Lateral overcoverage in 32.1% (59/184) of hips, including LCEA > 35° in 11.4% and an AI ≤ 0° in 30.4%. A PRIS was present in 38.6% (71/184) of hips and a PWS in 55.4% (102/184). No association was seen between the presence of lateral overcoverage and a positive COS (p=0.689). Pincer-type morphology was classified as global overcoverage in 21.7% (23/106), true hemipelvis retroversion in 28.3% (30/106), and focal anterosuperior overcoverage in 50.0% (53/106).

CONCLUSIONS: Pincer-type morphology can be subclassified as global overcoverage, true hemipelvis retroversion, and focal anterosuperior overcoverage. Focal anterosuperior overcoverage (50.0 %) was most common, followed by true hemipelvis retroversion (28.3%) and global overcoverage (21.7%). Recognition of the subtype of pincer-type morphology is important for appropriate operative treatment.

75. Return to Sports After Periacetabular Osteotomy

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SUMMARY: A large number of patients are able to return to athletic participation after periacetabular osteotomy.

INTRODUCTION: Periacetabular osteotomy (PAO) has become the preferred osteotomy technique for correction of symptomatic acetabular hip dysplasia in many centers of North America. Some patients are involved in competitive sports and wish to return to athletic participation after PAO. There is a paucity of data regarding the ability of patients to return to sporting activities after PAO. The objective of this paper was to assess patient activity using validated outcome scores before and after PAO for the treatment of symptomatic acetabular dysplasia.

MATERIALS AND METHODS: A prospective, multicenter hip preservation database was reviewed to select patients who had undergone a PAO with a preoperative UCLA score of 8 or higher. Fifty-six hips in 49 patients had preoperative and postoperative data at a minimum one-year follow-up. Thirty-six hips were in females and the average age at the time of surgery was 23.8 (10 to 48). Functional analyses were performed preoperatively and at one year and included the UCLA, modified Harris Hip, Marx activity scale, and HOOS score.

RESULTS: There were no revisions or reoperations except for four hips that underwent hardware removal. There was a statistically significant decrease in average UCLA score from 9.3 to 8.4 at 1 year ($p<0.010$), but 31 hips had either the same or improved score at that time. There was also a decrease in Marx activity scale from 9 to 7.5 ($p=0.06$), but this did not reach significance. There was a marked increase in both the average modified Harris hip score from 68 to 91 ($p<0.01$) and the average HOOS score from 55.2 to 88.88 ($P<0.001$) at one year.

DISCUSSION: In this select group of active patients undergoing PAO, there was a significant decrease in average UCLA scores from preoperatively to one year. More than half of the patients, however, had no change or increase in their scores and continued to be highly active in competitive impact sports. This data should be used to counsel patients prior to PAO. Additional study is required to determine if the UCLA/Marx score decreases are due to activity modification, physician recommendation, or functional limitations.

76. Revision Hip Preservation Surgery: Indications and Surgical Technique Profile

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INTRODUCTION: Hip preservation surgical procedures have become more commonplace over the past decade. While the majority of patients are reported to have decreased pain and improved function after these procedures, there are subpopulations of patients who do not benefit from surgery or have recurrent hip symptoms over time. The purpose of this study is to characterize patients who fail hip preservation surgery, determine the etiologies of failure, and report the profile of revision hip preservation surgical procedures.

METHODS: A prospective, multicenter database of 1,300 hip preservation procedures was queried to identify all cases with previous hip preservation procedures. Patient demographics, etiology of failure, and type of revision surgery performed were analyzed.

RESULTS: Patients with failed joint preservation surgery present at an average age of 25 years. Sixty-eight percent are females and 32% males. The failed primary procedure was osteotomy in 30%, arthroscopy in 45%, SCFE pinning (14%), and surgical dislocation in 17%. The common indications for revision joint preservation surgery included residual dysplasia (32%), FAI (45%), Perthes deformity, SCFE, and internal derangement (38%). Revision procedures required for treatment included arthroscopy (39%), PAO (38%), and surgical dislocation (47%).

CONCLUSIONS: Patients with failed hip preservation surgery are young and potentially active. Residual structural disease of the hip is a common factor associated with failure of primary hip preservation procedures. Revision treatment encompasses a full spectrum of hip preservation procedures (osteotomy, surgical dislocation, and hip arthroscopy).

77. The Reliability of Hip Arthroscopy Labral and Chondral Disease Classification

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BACKGROUND: The results of arthroscopic treatment of femoroacetabular impingement have been increasingly reported. Yet, the reliability of arthroscopic classification of hip disease has not been defined.

PURPOSE: To determine the interobserver and intraobserver reliability of the arthroscopic Beck's classification of labral and articular cartilage pathology.

METHODS: Four experienced hip arthroscopists reviewed standardized arthroscopic videos of 40 patients. Arthroscopic findings were classified using Beck's classification of labral and articular cartilage disease, as well as a modified labral classification. Repeat classification of videos was performed several weeks later. The reliability of arthroscopic classification was defined using the agreement rates and the average weighted Cohen's kappa values.

RESULTS: Arthroscopic classification of labral disease using the Beck classification demonstrated moderate-substantial interobserver reliability (average kappa 0.62, range 0.48-0.78) and an overall agreement rate of 81.7%. The differentiation between labral degeneration and labral detachment was a common source of disagreement. The reliability of a modified classification improved to substantial-excellent (average kappa 0.78, range 0.69-0.86). Similarly, Beck's classification of articular cartilage disease had moderate-substantial interobserver reliability (average kappa 0.65, range 0.49-0.78) and overall agreement rate of 57.5%. A simplified classification of articular cartilage findings resulted in an average weighted kappa value of 0.68 (range 0.53-0.76) and an overall agreement rate of 74.1%.

CONCLUSIONS: The classification of hip arthroscopic labral and articular cartilage findings have substantial interobserver reliability. This level of reliability is similar to previously reported arthroscopic disease classifications in the knee and shoulder. These classification systems are appropriate for future outcome reporting of hip arthroscopy.

78. Hip Arthroscopy in Adolescents: Predictors of Prolonged Recovery

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PURPOSE: Hip arthroscopy is an accepted procedure for the treatment of labral pathology in adult patients. Recovery from this procedure is typically rapid with a favorable outcome; however, a subset of patients experience prolonged recovery. Furthermore, patients often have a delayed presentation, due to attempts at conservative treatment. This study was undertaken to examine the early postoperative course of hip arthroscopy for labral tears in adolescents and the effect of preoperative physical therapy on their subsequent recovery.

METHODS: We retrospectively reviewed all patients under the age of 25 who underwent hip arthroscopy at our institution between 2003 and 2009. Multivariate logistic regression was employed to create an algorithm predicting risk of prolonged recovery using selected baseline characteristics. Prolonged recovery was defined as persistent symptoms beyond two months postoperatively.

RESULTS: Forward selection resulted in a stable model consisting of four significant risk factors for prolonged recovery. These included preoperative participation in physical therapy ($p=0.007$), synovitis found during arthroscopy ($p=0.03$), and the presence of a lateral or posterior inferior labral tear ($p=0.001$ and $p=0.05$, respectively).

DISCUSSION: In our study of adolescent patients undergoing hip arthroscopy, patients who had preoperative physical therapy were more likely to experience prolonged recovery after surgery. Additionally, intraoperative findings of significant synovitis, and lateral or posterior inferior labral tears were also predictive of longer recoveries. Given these findings, it is possible that in the presence of a labral tear, preoperative physical therapy tends to exacerbate the problem leading to a more inflamed joint resulting in a prolonged recovery.

CONCLUSION: Consistent with a prior study in adults, a lateral labral tear was a predictor of prolonged recovery in our study. Physical therapy, however, is a unique predictor of prolonged recovery. While preoperative physical therapy may prevent surgery in some cases, it appears to prolong recovery in this patient population.

79. Results of Central Compartment Arthroscopic Iliopsoas Tendon Releases for Treatment of Labral Impingement

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BACKGROUND: Although the success of arthroscopic iliopsoas tendon releases performed at the lesser trochanteric and femoral neck has been well documented, the efficacy of tendon releases performed in the central compartment has not been established. This study evaluated the results of 30 patients that had an arthroscopic iliopsoas tendon release performed at the level of their labrum to treat a tight psoas tendon that was impinging upon a torn or inflamed labrum.

METHODS: All 30 patients had preoperative MR arthrograms that included injection of the hip with ropivicaine. Ten had minimal relief of their hip pain after the intra-articular injection, and, thus, had an ultrasound evaluation of their psoas tendon and an anesthetic injection into the psoas bursa. In all 10 patients, the bursal injection relieved their pain, and in 5, real time imaging demonstrated snapping of the tendon at the iliopectineal eminence. All 30 patients had hip arthroscopy performed in the supine position and an arthroscopic release of the tendinous portion (40%) of the iliopsoas musculotendinous unit at the level of the labrum. All hips were assessed with Byrd's 100-point modified Harris hip scoring system prior to the release and at 3, 6, and 12 months after surgery.

RESULTS: The average age of the 30 patients was 35 years, and their preoperative scores averaged 43 points. After surgery, the patients used crutches for two to four weeks and had six-week scores that averaged 70 points. Six and 12 months after surgery, their scores averaged 73 and 82 points, respectively. Over the first postoperative year, three patients developed recurrent pain and snapping in their hip. All three had iliopsoas bursa injections and experienced immediate relief of their hip pain. In two patients, the relief was temporary and an arthroscopic release of the tendon at the lesser trochanter is being considered.

CONCLUSIONS: An arthroscopic release of the iliopsoas tendon at the level of the labrum is effective for alleviating hip pain from labral lesions caused by impingement of the tendon. In those patients with hip pain due to snapping of the tendon, the results of central compartment release are less predictable and recurrent snapping may occur.

80. Does Iatrogenic Damage to the Articular Cartilage Affect the Results of Hip Arthroscopy?

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BACKGROUND: Although surgeon-induced damage of the articular cartilage is estimated to occur in 18% of hip arthroscopies, the consequences of these iatrogenic events have not been documented. This study examined the effects of these inadvertent scrapes and scuffs by comparing the clinical results of patients with iatrogenic articular cartilage injuries (IAI patients) to those of patients that did not have articular cartilage injuries (NAI patients) during their hip arthroscopy.

METHODS: From a database of 700 patients who had their hip arthroscopy performed by the senior author, 52 patients with IAIs and one or more years of follow-up were identified. The pre- and postoperative modified Harris hip scores of the 52 IAI patients were compared to those of a matched-group of 52 patients that did not sustain iatrogenic articular injuries (NAI patients).

RESULTS: Preoperative scores for the IAI and NAI patients averaged 43 points. At surgery, 17 of the IAI patients had needle scrapes (18 gauge spinal needle, scrape length 3-8 mm), and 35 sustained cannula scuffs (5 mm width, scuff length 3-8 mm). After surgery, the 6-month scores averaged 84 and 86 points, and the 12-month scores averaged 85 and 87 points, respectively, and there were no significant differences ($p>0.05$) between the two groups. Average joint distraction for the IAI and NAI patients was 12.6 mm (range 9-18 mm) and 12.9 mm (range 8-18 mm), respectively. The average and range of joint distraction was the same for both groups of patients ($p=0.6$), and achieving even 18 mm of joint distraction did not prevent IAIs from occurring. The number of patients that had arthroscopic treatment of femoroacetabular impingement (56% IAI vs. 42% NAI patients), and the incidence of both pincer (31% vs. 25%) and CAM deformities (37% vs. 29%) were significantly higher ($p<0.01$) in the IAI patients.

CONCLUSIONS: Iatrogenic articular cartilage damage was: (1) more common in patients with femoroacetabular impingement, (2) not prevented by the amount of joint distraction achieved, and (3) did not affect the one-year outcomes of patients who sustained these iatrogenic cannula scuffs and needled scrapes during hip arthroscopy.

81. The Outcomes of Hip Arthroscopy and Limited Open Capsular Plication for Treatment of Atraumatic Hip Instability

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INTRODUCTION: Atraumatic hip instability is characterized by insufficient soft tissue constraint leading to symptomatic hip laxity in the absence of structural dysplasia. This is an uncommon cause of hip pain in young adults. Very limited information exists on the outcomes of patients treated for atraumatic hip instability. The purpose of this study is to report short-term outcomes of patients treated with hip arthroscopy and limited open capsular plication for atraumatic hip instability.

METHODS: Eleven patients (12 hips) were treated with hip arthroscopy and limited-open capsular plication. Capsular plication was indicated for hips with signs and symptoms of joint instability and capsular laxity in the absence of hip dysplasia (3.5% of all hip arthroscopy cases). Among the study group, arthroscopic procedures included: labral repair/partial debridement (83%), chondroplasty (50%), and osteochondroplasty (67%). All hips had a limited open capsular plication and were braced for six weeks. Outcome scores included modified Harris Hip Score (HHS), UCLA Activity Score, WOMAC, and the SF-12.

RESULTS: Average patient age was 27 years; all were female and followed a minimum of 6 months (average 16 months). Three hips had an associated connective tissue disorder and nine had generalized laxity. The HHS improved from a mean of 54.9 preoperatively to a mean of 88.6 postoperatively ($p<0.001$). UCLA activity score improved from a mean of 5.9 preoperatively to 7.2 postoperatively ($p=0.018$). The WOMAC improved from a mean of 43.3 to 12.5 ($p=0.003$). No patient underwent further surgery during the study period.

DISCUSSION: Atraumatic hip instability in the absence of hip dysplasia is uncommon and is difficult to treat surgically as optimal treatment strategies have not been established. Hip arthroscopy with combined limited open capsular plication provides opportunity to address intra-articular disease as well as capsular laxity. At early follow-up, this surgical strategy has provided excellent results for most patients. Atraumatic hip instability treated with hip arthroscopy with combined limited open capsular placation has excellent results at early follow-up.

MAOA BREAKOUT SESSION #7
TRAUMA
April 20, 2012

82. Silver Negative Pressure Dressing with Vacuum-Assisted Closure of Massive Soft Tissue Loss Involving the Pelvis and Extremities

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Massive pelvic and extremity soft tissue loss remains a complex and cumbersome problem. Infection is often responsible for delayed healing, persistent drainage, pain, and other complications. Vacuum-assisted closure (VAC) technology has proven to be effective in the management of soft tissue loss from infections, vascular insufficiency, radiation-induced soft tissue necrosis and traumatic disorders. The use of a silver dressing in conjunction with the VAC may inhibit the colonization of drug resistant organisms and sustain early granulation leading to expedited healing. There is little evidence that bacteria develop resistance from continuous exposure to silver concentrate. Silver has been associated with reduced inflammation and modulation of matrix metalloproteinases in studies regarding the effects on burn patients. Silverlon™ is a highly concentrated negative pressure dressing that is a knitted fabric dressing that has been silver-plated by means of a proprietary autocatalytic chemical (reduction-oxidation) plating technique. This is the first study in the literature describing the use of a silver negative pressure dressing in combination with the wound VAC as well as a single institution's experience with VAC technology in the management of massive soft tissue defects involving the pelvis and/or extremities. Between January 2003 and January 2010, 42 patients were treated for massive pelvic and/or extremity wounds (>20 cm) and were managed with the VAC device. In a subgroup (n=16) of these patients, a Silverlon™ negative pressure dressing was used. Hospital stay ($p<0.025$), length of overall treatment ($p<0.025$), number of operative debridements ($p<0.05$), and success of wound closure without the need for soft tissue transposition ($p<0.01$) was found to be significantly less in the silver negative pressure dressing group compared to those with the VAC device alone. The adjunct use of a silver negative pressure appears to have several benefits and may be used safely in the management of massive soft tissue defects whenever wound VAC therapy is applicable.

83. Contrasting Structural and Biomechanical Responses of Sub-Critical and Critical Defects on the Bone Healing Capacity in Murine Femoral Defect Injury of a Femoral Murine Nonunion Model

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Osseous healing typically progresses through a facile and well-orchestrated series of defined biological processes. However, certain fracture patterns are at risk for delayed healing or non-union, and the exact molecular mechanisms behind this perturbed healing process are not yet fully understood. Reliable murine models of nonunion fracture healing could provide a potent tool for understanding the poor healing process, especially given recent advances with transgenic animal models and genetic manipulation techniques. In this study, we developed a unique fracture fixation technique in double transgenic (Col1/Col2) mice to investigate both sub-critical defects leading to fracture unions and longer, critical defects leading to nonunions. We analyzed histology at two and five weeks post-surgery and torsional biomechanics and μCT at five weeks. Subcritical (0.6 mm long) defects healed histologically at both time points with elevated Col1 expression, no Col2 expression, and no significant differences in torsional stiffness or strength compared to nonoperated normal and sham controls. However, critical (1.4 mm long) defects showed no healing by histology or μCT with minimal Col1 and no Col2 expression. These nonunion fractures also displayed minimal torsional stiffness and strength, with only 2 of 12 samples showing any measurable properties. To our knowledge, we have created the first reproducible murine nonunion fracture model employing plate and screw fixation. This model can serve as an ideal platform for studying molecular pathways to contrast healing versus nonhealing events and for developing innovative treatment approaches like tissue engineering strategies using cell-based therapy, growth factors, and/or biologic scaffolds.

84. Gait Analysis After Retrograde and Trochanteric Entry Intramedullary Nail Fixation of Femoral Shaft Fractures

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PURPOSE: The entry starting point for femoral nailing continues to be the focus of debate. Current dogma suggests that retrograde nailing leads to knee pain. Yet the effects of retrograde nailing on gait have not been thoroughly determined. The purpose of this study was to evaluate entry portal influence on gait and stair climbing status following retrograde and trochanteric entry nailing.

METHODS: IRB approved inclusion criteria included adult patients with isolated femur fractures treated with intramedullary nails that were clinically and radiographically healed and demonstrated at least six months of device free ambulation. Demographic and fracture data were collected on the participating subjects. Subjects then completed a Musculoskeletal Function Assessment (MFA) questionnaire, walked on a treadmill, and demonstrated up and down stair climbing ability. Videotape analysis of all subjects was done by one physician using model software. Data collected included observations of antalgic gait and gait asymmetry on both the treadmill and stair ascent/descent. Additional data points included velocity of gait and hip and knee angles at toe-off and heel-strike. Statistical analysis was completed using descriptive methods to calculate mean and standard deviation. Frequency tables were used for calculation of categorical data significance and Mann Whitney U tests for nominal data sets.

RESULTS: Sixteen patients underwent gait analysis. Subjects were separated into groups based on entry portal location: 8 trochanteric entry and 8 retrograde intramedullary nails. The average age of the patients was 29 (range: 22-44) in the trochanteric entry group and 32 in the retrograde group (range: 22-45). The average length of time from injury to participation in the study was 24 months (range: 10-41). There was no significant difference between the groups on the MFA questionnaire ($p=.127$). No differences were noted in subjective measures of gait or stair climbing. When evaluating the kinematics of the knee, no significant difference was measured of the normal or affected knee at heel-strike ($p= .550$ and $.154$) or at toe-off ($p= .527$ and $.669$). When comparing the hip kinematics between entry portal groups, trochanteric entry patients demonstrated significant differences on the normal limb at toe-off ($p<.05$) and on the affected limb at heel strike ($p<.05$), but no significant difference was seen in the normal hip at heel-strike ($p=.057$) or the affected extremity at toe-off ($p=.288$).

CONCLUSION: Previous studies have shown significant effects from antegrade femoral nailing in terms of hip abductor function and lower extremity biomechanics. No such studies exist looking at retrograde femoral nailing or comparing the two methods. Although we found no subjective difference in how a patient perceives their lower extremity function, there is an effect on hip function at toe-off of the normal and heel-strike of the affected leg in the trochanteric entry nailing group that is not seen in the retrograde group. Although retrograde nailing does involve the knee joint for proper entry portal placement, it does not have any significant effect on gait function. In conclusion, trochanteric or retrograde nailing may lead to some of residual discomfort to the patient, but trochanteric entry nailing has the potential to cause a mechanical disturbance in gait. Patients treated with retrograde nails did not demonstrate gait disturbances.

85. Spanning External Fixation for Complex Distal Femur Fractures: Indications and Outcomes

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PURPOSE: The use of temporary spanning external fixation for the staged reconstruction of severe tibial plateau and plafond fractures has been well documented. Indications for their use in these injuries includes concomitant soft tissue compromise, severe open fractures with and without arterial injury, fracture in association with compartment syndrome, and use in the management of the polytrauma patient for damage control. Use of this concept for distal supracondylar/intracondylar femur fractures has been referred to; however, no specific data has been reported when used for these specific fracture patterns. The purpose of this study was to evaluate temporary spanning external fixation with regard to indications, complications, and outcomes of this technique when used for the staged reconstruction of complex supracondylar and intracondylar distal femur fractures.

METHODS: An IRB approved retrospective review of our trauma database was performed to identify all distal supracondylar/intracondylar femur fractures. Chart and x-ray analysis was undertaken to identify the use of and indications for temporary knee spanning external fixation. Methodology of external fixation was identified as was injury and patient demographics for all distal femur fractures. Complications of external fixation were identified, as well as data regarding definitive surgical stabilization. This was compared to those patients that did not undergo initial spanning fixation to determine if any detrimental effects were attributable to this technique.

RESULTS: Thirty-three out of 135 identified distal femur fractures underwent temporary spanning fixation prior to definitive ORIF. Indications for ex fix included severe open fractures Gd III, fractures with arterial injury, damage control measures, or all three. For 75% of fixators, Schantz pins were inserted into the distal condylar segments, to reduce the severe extension deformity that is commonly produced when spanning these injuries. Surgical time, nonunion rates, and incidence of deep infection were not significantly different from the cohort that did not have temporary external fixation prior to definitive ORIF. There were no complications attributable to the ex fix frame alone.

CONCLUSIONS: Temporary spanning external fixation is a valuable technique for the management of complex distal supracondylar/intracondylar femur fractures. This allows for the timely stabilization of these injuries in the face of severe open fractures, vascular reconstruction, and the resuscitation of the polytrauma patient. The principle of avoiding placing fixation pins into the distal femoral segment is unfounded, as the majority of our patients benefited by this method with improved reductions which facilitated eventual definitive reconstruction, and no detrimental effects or complications occurred compared to those patients that did not receive the knee spanning ex fix.

86. Clinical Outcome of Tibial Plateau Fractures Related to the Posterior Slope

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PURPOSE: The purpose of this study was to determine if sagittal alignment and posterior slope of the tibial plateau influences range of motion, development of osteoarthritis, and subjective patient based clinical functional outcome.

METHODS: Between 2002 and 2005, 196 consecutive patients with 197 tibial plateau fractures underwent internal fixation at a Level 1 trauma center. Following exclusions, 94 were prospectively evaluated. Imaging and clinical evaluation were performed at 2, 6, 12, 26, 52, and 104 weeks. SMFA and SF-36 surveys were obtained from the patients at 6, 12, and 24 months. The inclination of the tibial plateau was measured.

RESULTS: Forty-six (48.9%) males and 48 (51.1%) females with an average age of 49 years (19-88) and BMI of 30.2 kg/m2 (17.4-49.9) were followed for 42 months (20-103). OTA/AO fracture classifications included: 3 (3.2%) 41A, 58 (61.7%) 41B, and 33 (35.1%) 41C. Posterior tibial slope measured 10.03 (-8 to 23) without a difference between male and female (p=0.89). Fifty-one patients (54.3%) received allograft augmentation. Forty-four patients (46.8%) underwent additional surgeries. Patients with posterior slope less than 5.5° had a mean loss of extension of 0.6° and a mean loss of flexion of 30° while patients with posterior slope >11.5° had a mean loss of extension of 2.35° but also a mean loss of flexion of 28°. Patients with anatomical alignment had a loss of extension of 1.4° and a loss of flexion of 20°. Loss of flexion correlates to Schatzker classification (p=0.04), but not to AO/OTA (p=0.42). The ability to flex the knee is related to clinical outcome in the short-term (6 months) and long-term (24 months). A relationship between final clinical outcome and anatomical reduction (step off <2 mm) existed for bother (p=0.03), physical functioning (p=0.01), role physical (p=0.02), and bodily pain (p=0.04).

CONCLUSION: Anatomic reduction should be achieved not only for articular congruity and varus/valgus alignment, but also for sagittal alignment. Posterior slope affects final tibial plateau fracture reduction ROM. Clinical outcome is related to ROM.

87. Neither Injury Severity nor Reduction Correlate with Outcome in Tibial Plateau Fractures

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PURPOSE: The purpose of this study was to assess the relative effect of injury severity and quality of fracture reduction on patient outcome after tibial plateau fractures. Apple iTunes software was used to allow expert clinician electronic rank ordering of images.

METHODS: The AP and lateral injury radiographs and post-treatment radiographs of 36 tibial plateau fractures were ranked from worst to best by three experienced orthopedic traumatologists at different institutions using Apple iTunes software and image podcasts; radiographs were displayed and stratified electronically at multiple institutions. The 36 patients were contacted by phone at least two years after injury and completed SF-12 and KOOS general and joint specific questionnaires. Lin's concordance was calculated to assess surgeon ranking agreement. Outcomes were correlated with the injury and reduction ranks using Kendall's tau-b concordance measure.

RESULTS: There was excellent agreement between raters for injury severity ranking (concordance = 0.86-0.91). Agreement on reduction was not as good as the injury ranks (concordance = 0.46-0.68). The average rankings for injury severity and reduction had a concordance of 0.65 indicating a moderate correlation. There was no significant association between the ranking of injury severity or the ranking of reduction and either the general or joint specific outcome measures.

CONCLUSION: Expert orthopedic traumatologists strongly agree on how to rank order tibial plateau fractures based on severity of injury and quality of reduction assessed on plain radiographs. It was surprising that despite the wide range of severity of these fractures that neither the injury severity ranks nor the reduction ranks significantly correlated with outcome. Other patient- and injury-related factors may be more important in determining the outcome of patients after tibial plateau fractures. Apple iTunes software and image podcasts provided an easy and user-friendly method for multi-institutional rank ordering.

88. Gritti-Stokes Amputations in the Trauma Patient

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SUMMARY: The Gritti-Stokes amputation technique appears to have advantages as compared to traditional transfemoral amputation, with improved patient outcomes in this retrospective study.

METHODS: Fourteen consecutive patients who underwent Gritti-Stokes amputation and 15 consecutive patients who underwent traditional transfemoral amputation were reviewed at greater than 14 months postoperatively. The Sickness Impact Profile (SIP) questionnaire was also administered to both patient groups at greater than 36 months postoperatively to assess patient-reported functional outcomes.

RESULTS: Despite the two groups not having significant differences in preoperative variables or demographics, the Gritti-Stokes group had significantly improved SIP Questionnaire overall and individual domain scores. This procedure left the patients with significantly longer residual limbs (residual femoral length average of 46.1 cm versus 34.5 cm for the transfemoral group). The Gritti-Stokes group also had a significantly increased rate of ambulation without assistive devices (35.7% vs. 0% for the transfemoral amputation group). No significant statistical differences were seen between the two groups in regards to the rate of perioperative complications, revision rate, or reoperation rate.

CONCLUSION: The Gritti-Stokes amputation appears to be safe when utilized in the trauma population. Although further investigation is warranted, this procedure appears to have potential benefits over traditional transfemoral amputation, including increased limb length, improved mobilization, earlier prosthesis wear, and enhanced patient-reported outcomes.

89. The Lateral Suprapatellar Approach to Tibial Intramedullary Nailing in a Semi-Extended Position: A Cadaver Study

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INTRODUCTION: Proximal tibial diaphyseal or metaphyseal fractures present a particular challenge during intramedullary nailing: a procurvatum deformity due to extensor mechanism over-pull. A suprapatellar approach in a semi-extended position may prevent this deformity, however, risks intra-articular damage. Additionally the question arises whether identical starting points can be achieved.

GOALS: 1. Outline intra-articular cartilage damage sustained during the lateral suprapatellar approach in cadaveric specimens. 2. Compare the starting points achieved between the lateral suprapatellar approach and the lateral parapatellar approach in terms of Tornetta's "safe zone".

METHODS: Five paired cadaveric specimens with intact extensor mechanisms were used. A tibial nail was placed in one knee via the traditional lateral parapatellar approach. A second tibial nail was placed in the contra-lateral knee via a lateral suprapatellar approach. An arthrotomy was then made and the chondral surfaces were examined for gross damage. Measurements of portal location were recorded and compared.

RESULTS: Two of the five suprapatellar specimens sustained gross cartilage damage along the lateral patellar facet. No parapatellar specimens sustained chondral damage. The starting portals for all lateral suprapatellar nails were medial to the "safe zone", while starting portals for parapatellar nails were within the "safe zone".

CONCLUSIONS: Tibial nail starting portals obtained via a lateral suprapatellar approach are medial to the midline of the plateau and tubercle, outside the "safe zone", thus, increasing the risk of chondral injury. The risk of patellofemoral chondral damage during a suprapatellar approach must be weighed against the risk of a procurvatum deformity encountered with classic nailing techniques.

90. Boomers on Bikes: Are There Increased Mortality Rates for Older, Injury-Matched Motorcyclists?

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PURPOSE: The industry statistics demonstrate an increasingly older population is riding motorcycles. This study was designed to identify the orthopedic injuries sustained by motorcyclists and their hospital outcomes stratified by age. We hypothesized patients over 50 years of age would have more complex injuries and have increased morbidity and mortality compared to younger patients.

MATERIALS AND METHODS: We identified all patients treated at a single institution after sustaining injury in a motorcycle collision (MCC) from 2004-2009. Demographic data, initial injury severity markers, and hospital outcome measures were collected including length of stay (LOS), intensive care days (ICU), ventilator days, morbidities, and mortality. Fracture radiographs were reviewed, and classified according to the AO/OTA classification system. Statistical analysis was performed with patients grouped into age < 50 years versus ≥ 50 years with $p \leq 0.05$ determined as significant.

RESULTS: There were 560 patients injured in an MCC. Of those patients, 118 (21%) were excluded due to no orthopedic injury, and 14 (3%) were excluded due to incomplete records. There were 436 patients remaining. Older patients presented with more medical co-morbidities ($p<0.001$). No significant difference was found for initial injury severity markers or fracture complexity. Older patients had a longer average LOS (12.92 vs. 10.24, $p=0.043$), ICU days (5.44 vs. 2.67, $p=0.001$), ventilator days (4.11 vs. 1.68, $p < 0.001$), and rate of complications (0.34 vs. 0.22, $p=0.013$) than younger patients. Older patients had a significantly higher mortality rate than younger patients in this study (6.8% vs. 2.4%, $p=0.04$).

CONCLUSION: Advanced age correlated with prolonged hospital stay, and requirement of more aggressive care. An increased risk of mortality was demonstrated for the older motorcyclist. However, age alone did not affect the severity or distribution of orthopedic injuries. As the riding population ages, it is important to understand the pattern of injuries, hospital course, increased mortality rates, and health care expenditure burden which can be expected.

91. The Effect of Age on Outcomes in Orthopedic Trauma Patients

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PURPOSE: To determine if orthopedic trauma patients greater than 65 years old are at higher risk for mortality, number and severity of injuries, complications, and longer hospital stays.

METHODS: After IRB approval, a three-year retrospective chart review of all orthopedic trauma patients was done to evaluate the effect of age on the above outcomes. A database was created to capture the following data points: patient demographics, mechanism of injury, comorbidities, procedures, complications, and outcomes.

RESULTS: 963 patients were identified, and 500 had sufficient data available for review. Elderly patients (> 65 years old) made up 15% of the population. Elderly patients were more likely to have injuries resulting from falls and were more likely to wear seatbelts when involved in motor vehicle crashes. However, they had a significantly higher ISS, and significantly longer hospital and days in the ICU. They accounted for 27% of total hospital days. Mortality rate was not significantly different.

CONCLUSIONS: A recent ACS review of our institution revealed that 50% of our trauma patients are age 55 or older. Nationally, 25% percent of trauma patients are over the age of 65. As the largest segment of the population continues to get older, we will see more and more elderly patients. As our review shows, lower energy mechanisms occur more commonly in these patients. Although mortality does not differ between age groups, ISS and length of hospital and ICU stays are higher in the elderly. No difference in mortality rate is likely due to the success of aggressive trauma and critical care protocols that reduce the risk of mortality by up to 50%. Since elderly patients account for a disproportionate amount of cost and resources, it justifies the continued need to more closely evaluate this demographic to identify the unique challenges they provide and improve their care such as management of osteoporotic fractures, medical comorbidities, and challenging physical rehabilitation protocols.

92. Concussive Injuries in Pediatric Motocross Riders: A Prospective Observational Study

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INTRODUCTION: In a recent retrospective study, 18% of youth motocross injuries presenting at our hospital involved closed head trauma despite protective headgear. This study prospectively followed youth motocross riders' concussive head injuries during the 2010 racing season.

METHODS: 202 motocross riders enrolled at one race track between May and October of 2010; 139 (69.2%) were < 18 years with a mean age of 12.2 years (range 5-17). Riders voluntarily completed questions detailing their length of sport participation, amount and intensity of training, type and usage of protective equipment, presence and frequency of concussive symptoms, orthopedic and concussive injury histories, and rider and parental attitudes toward the sport. Associations were evaluated using JMP statistical software to run Pearson's chi-square tests and St. John's University on-line exact contingency tables.

RESULTS: 127 (91.4%) males and 12 (8.6%) females at a mean age of 12.2 years (range 5-17) completed surveys. Sixty-seven (49.6%) riders had known concussions from riding/racing (mean number of concussions 1.37, 95% CI 1.02-1.72); 51 (73.9%) suspended participation for a mean of 2.7 weeks (range 0-36 weeks, median 1 week).

136 (98.6%) always wore a helmet while riding; 100 (72.5%) received help fitting their helmet before purchase; 66 (47.8%) received sponsor support for riding. Concussion symptoms included: 24 (17.8%) reported memory or concentration problems, 37 (27.2%) felt sluggish or hazy, 21 (15.4%) photo/phonophobia, 42 (31.0%) headaches or head pressure, 19 (14.1%) nausea or vomiting, and 35 (25.9%) head did not "feel right".

Forty-one (30.1%) continued racing the same day as these symptoms; only 52 (38.2%) obtained a health care examination for symptoms. Multiple concussions from any source were reported by 46 (38.2%) riders; 103 (76.3%) self-reported crashes from aggressive riding/racing.

Sponsor support conferred a relative risk of 1.48 (1.05-2.08) of concussion (p=0.0244); reports of crashes from aggressive riding were associated with a 1.79 relative risk (CI 1.04-3.07) of concussion (p=0.015).

Receiving help fitting a helmet before purchase was associated with a 41% decreased risk (RR= 0.59 [CI 0.44-0.81]) of concussion (p= 0.0032).

CONCLUSIONS: Fifty percent of pediatric motocross riders self-reported concussive symptoms; only 40% obtained a health care examination, and 30% continued racing that same day. Risk of concussive injury can be decreased for pediatric motocross riders by receiving help fitting their helmet before purchase. Sponsor support and crashes from aggressive riding increase concussion risk.

93. Extra-Articular Distal Humerus Fractures: Is One Plate Enough?

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INTRODUCTION: Metaphyseal comminution and poor bone quality can make extra-articular distal humerus fractures challenging to manage. Stable reduction and fixation of this fracture pattern is required to allow for early active motion to produce the best possible result. Decreasing morbidity, minimizing operative time, and surgical dissection is also desirable. Locking plate could accomplish these goals by using one plate instead of two. Our hypothesis is that a single posterolateral locking plate used for fixation of extra-articular distal humerus fractures provides a construct with axial and torsional stiffness comparable to that of dual non-locked plates, in either a 90° or 180° configuration.

METHODS: Eighteen synthetic humeri were divided into three fixation groups (n=6): (1) medial and lateral 3.5 mm reconstruction plates at 180°, (2) medial and posterolateral 3.5 mm reconstruction plates oriented at 90°, and (3) single pre-contoured distal humerus metaphyseal locking plate. A 1 cm transverse osteotomy was created 4 cm from the distal articular surface and plates were applied. Stiffness in the sagittal plane, lateral bending, and torsion were evaluated. 3D evaluation was done using optical tracking.

RESULTS: Single metaphyseal locking plate constructs had significantly greater sagittal plane stiffness ($p<0.01$). 90° and 180° plating constructs had greater lateral bending stiffness ($p=0.33$ and $p=0.59$). 180° plating had the greatest torsional stiffness ($p<0.01$).

DISCUSSION: A single metaphyseal locking plate is clinically useful for extra-articular distal humerus fractures. This study revealed that this construct is significantly stiffer in the sagittal plane, the main plane of motion of the elbow, and comparable to traditional two-plate constructs in secondary planes of elbow motion. Although 90° plating was stiffest in the coronal plane and 180° plating was stiffest in torsion, they are inherently more invasive. The single locked plate allows for a less invasive construct that potentially decreases the risk of neurovascular injury and devascularizing the bone by limiting surgical dissection.

MAOA BREAKOUT SESSION #8
TOTAL JOINT COMPLICATIONS
April 20, 2012

94. Predictors of Readmission After Total Hip and Total Knee Arthroplasty

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INTRODUCTION: Readmission after total hip arthroplasty (THA) or total knee arthroplasty (TKA) places a great burden on the health care system. As reimbursement systems place increased emphasis on quality measures such as readmission rates, identifying and understanding the most common drivers for readmission becomes increasingly important.

METHODS: We queried an electronic database for all patients who underwent THA or TKA at our institution from 2006 through 2010. We identified those who were readmitted within 90 days of discharge from the initial admission and set this as our outcome variable. We then reviewed demographic and clinical data such as age, index procedure, length of stay (LOS), readmission diagnosis, comorbidities, and payer group and set these as our variables of interest. We used chi-square tests to characterize and summarize the patient data and logistic regression analyses to predict the relative likelihood of patient readmission based on our control variables. Statistical significance was defined as $p < 0.05$.

RESULTS: 6,436 patients underwent THA or TKA during the study period. Patients who were readmitted had a significantly higher mean LOS (4.7 days vs. 3.4 days, $p < 0.0001$). Patients with any comorbid conditions (e.g., CHF, COPD, diabetes, PE, CAD) had higher readmission rates than those with none (18.7% vs. 7.8%, $p = 0.0002$). Adjusting for patient age, sex, race, payer type, and LOS, those with CHF or CAD were more likely to be readmitted compared to those without CHF or CAD (CHF: odds ratio [OR]=1.71, 95% confidence interval [CI]=1.03-2.84; CAD: [OR] =1.93, 95% CI=1.48-2.53).

CONCLUSIONS: In our analysis of patients undergoing THA and TKA between 2006 and 2010, we found significant associations between readmission and higher LOS during initial admission and the presence of comorbidities. Longer than average LOS and the presence of comorbidities may be early predictors of readmission and warrant further study.

95. Validity, Accuracy, and Clinical Utility of a Risk Calculator for Total Knee Arthroplasty

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INTRODUCTION: Various comorbid conditions contribute to perioperative complications and prolonged hospitalization in patients undergoing primary total knee arthroplasty (TKA). Utilizing the Medicare Provider Analysis and Review (MEDPAR) dataset, an objective, preoperative TKA risk calculator was created based on select comorbidities. Our objective is to assess the validity, accuracy, and clinical utility of the TKA risk calculator on our local patient population undergoing primary TKA.

METHODS: We retrospectively identified and reviewed 2,284 patients undergoing primary TKA at a single institution from 2000-2008. Patient age, sex, and the existence of various preoperative comorbidities were collected for each patient. Using the TKA risk calculator, an objective, numerical complication risk based on select preoperative comorbid conditions was established for each patient. Actual complications occurring within the first 14 postoperative days were recorded. Statistical analysis was performed using the C-statistic and ANOVA test.

RESULTS: The TKA risk calculator produces estimates that are statistically significant. Patients with higher predicted probability of a complication did show higher complication rates. The corresponding C-statistic was 0.609. (95% Confidence Interval: 0.542 - 0.677). Dividing the patients into four groups based on their calculated complication risk (0-5%, 5-10%, 10-25%, >25%) demonstrated that our population had a consistently lower rate of observed complication than predicted across all four groups. However, the statistical significance of the associated ANOVA was $p < .001$, showing again that patients with higher predicted risk experienced more complications, and those with lower predicted risk experienced fewer complications.

CONCLUSION: The TKA risk calculator represents a useful development of an objective risk assessment instrument for patients undergoing TKA. To our knowledge, it is the first such device utilized for TKA. Based on our results, the calculator is valid and clinically relevant. Individualized counseling regarding the risk of perioperative TKA complications may be conducted using objective information.

96. Developing a Novel Risk Stratification Model to Predict Resource Utilization and Outcomes After Total Joint Replacement Surgery

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INTRODUCTION: Health care spending continues to rise at a significant rate, stimulating renewed interest in providing reform through the concept of Value Based Purchasing. One approach to offering value in healthcare delivery is the episode of care (EOC) model that identifies the resources required to manage a specific condition over a finite period of time. Although several studies have investigated the role of those various factors responsible for adverse outcomes following lower extremity TJR surgery, we are unaware of any reports examining the impact of such risk factors on resource utilization, cost, and outcomes. The purpose of this study was to evaluate whether increase in resource utilization was due to presence of comorbidities and whether this was correlated with an impact on outcomes.

METHODS: This study's primary outcome, resource utilization, and outcomes following TJR surgery, was evaluated by investigating the effect of socioeconomic characteristics, comorbidities, intraoperative factors, and patient preferences. We utilized the hospital system's claims database to evaluate pertinent charges and payments levied specific to our patient population of joint replacement patients during their EOC. Data was mined from the claims database and this financial data for an episode was linked to the specific medical information obtained from the electronic medical record systems within our health system. Each patient chart encounter for their EOC was reviewed for perioperative complications, intraoperative factors, compliance with SCIP measures, discharge disposition, and interval changes in health status. A multivariate analysis was utilized for all data elements to determine which potential outcome predictors were significant. Using this approach, a risk stratification nomogram was developed to predict resource use and outcomes in prospectively enrolled patients undergoing TJR surgery during their EOC.

RESULTS: 679 hospital system employees underwent primary TJR surgery from 2007 to 2010. The patients were grouped into the following categories based on procedure: 221 THA, 346 TKA, 103 UKA, 9 with previous hip surgery with conversion to THA. There was wide variability in the resources required to complete an EOC among this cohort, not all of which could be attributed to patient and process specific variables. Obesity was the most commonly occurring comorbidity followed by diabetes, hypertension, and anemia. The presence of multiple comorbidities yielded higher costs and increase resource care without improving outcomes. Variability was found among surgeons' use of resources. Variations in operating room use, hospital length of stay, and discharge disposition could not be explained by variance in patient or disease characteristics.

DISCUSSION AND CONCLUSION: Although variability exists among EOC for the same disease and treatment dyad, only a portion of the variability can be explained based on a model that accounts for patient specific comorbidities. This information is of significant benefit to health systems and payers as they attempt to predict the resources required to deliver care. Such modeling can help manage expectations with regard to clinical course and cost, and can serve as a basis for discussions to eliminate variability in care pathways that are not reflective of underlying clinical need.

97. Assessing Re-Admission Databases: How Reliable is the Information?

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INTRODUCTION: Databases may be valuable in shaping healthcare policy, including consideration for reimbursement. Prior reports suggest that medical complications constitute a large proportion of 30- and 90-day readmissions following total hip arthroplasty (THA) and total knee arthroplasty (TKA). However, the reliability of coding information entered into the databases may be difficult to validate on a large scale. In this study, we assess the reliability of readmission data obtained from an institutional database at a large teaching hospital.

METHODS: A five-year retrospective study was performed of all 30- and 90-day readmissions associated with a CPT-code for THA (81.51) or TKA (81.54). We identified 738 THA and 757 TKA readmissions. The readmission diagnoses were stratified by ICD-9 code, and subcategorized based on subspecialty/complication type. After individual cases were reviewed, we excluded ER visits, encounters unrelated to the index procedure and/or occurring > 90 days after the index procedure. 167 readmissions for 118 THA/TKA patients remained.

RESULTS: Initial review suggested that the most common reasons for readmission were medical (36%), joint specific (19%), postoperative complications (13.5%), other musculoskeletal (12.5%), other surgical subspecialty (10%), and infection (8%). After exclusions, the most common reasons for readmission were wound related (28.9%), bleeding related (18.9%), medical (10.9%), joint specific (9.6%), VTE (7.5%), and clostridium difficile infection (7.5%).

DISCUSSION AND CONCLUSION: Initial data review appeared concordant with other reports that medical conditions pose the greatest risk for hospital readmission following THA/TKA. However, more detailed review indicated that complications related to the surgical wound or perioperative prophylaxis constitute the majority (54.9%) or readmissions at our institution, while medical complications did not frequently result in hospital readmission. The findings of our study may raise some question to the validity of information obtained from larger databases without closer scrutiny.

98. Predicting Major Postoperative Complications After Hip and Knee Arthroplasty. Development of a Novel Nomogram, the Morbidity and Mortality Acute Predictor for Arthroplasty (arthro-MAP)

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PURPOSE: To develop a simple, but comprehensive predictive tool for immediate postoperative complications after hip and knee arthroplasty based on pre- and intraoperative variables.

METHODS: Data on procedures, comorbidities, and immediate outcomes during hospitalization were collected from all patients undergoing primary and revision hip and knee arthroplasty from March 2003 to March 2006 (N=3511) at a tertiary care center. Logistic multivariable regression analysis was derived to serve as basis for a nomogram. Bootstrapping was used to correct for overfitting bias for both discrimination and calibration. Net reclassification improvement was used to compare model performance to the Surgical Apgar Score.

RESULTS: With the exception of race and lowest heart rate, all variables included in the multivariable logistic regression model were found to be statistically significant predictors of postoperative complications. The nomogram derived from this model had a concordance index (bootstrap-corrected) of 0.757. This compares favorably to that of the Surgical Apgar Score (0.612), and also was well calibrated. Compared to the Surgical Apgar Score, the NRI was 71.5%, 18.4%, and 53% among patients with or without complication respectively.

CONCLUSION: We developed an easy to use novel clinical prediction tool for immediate postoperative risk for major complications in hip and knee arthroplasty, the Morbidity and Mortality Acute Predictor for arthroplasty (arthro-MAP). This nomogram provides a tool to risk stratify patients and potentially educate patients and their families about major postoperative complications. It may also serve as a tool for longitudinally assessing quality and safety improvement interventions and their effect on surgical interventions. This will need to be validated in different populations and settings.

99. Predictive Modeling of Early Major Complications in Patients 65 and Older After Total Knee and Hip Arthroplasty

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INTRODUCTION: Major complications (i.e., life-threatening or complications requiring complex surgical/medical intervention) are more common in patients 65 years and older after total knee or hip arthroplasty (TKA or THA). Developing a model to predict major complications may assist with preoperative planning, patient counseling, and the development of prevention protocols. The purpose of this study was to develop and validate a predictive model of major complications after total joint arthroplasty in this vulnerable population.

METHODS: A cohort of 502 consecutive patients 65 years and older undergoing TKA or THA were followed prospectively. They underwent 550 procedures (n=304 TKA; n=48 bilateral (B/L); n=198 THA). Demographics, patient characteristics including body mass index (BMI), laboratory data, medications, comorbidities (including Charlson Comorbidity Index [CCI]) and major postoperative complications within 90 days were collected from electronic medical records. A multivariate logistic regression model was built with all significant predictors from univariate analyses. The model with the highest concordance index (C-index) was chosen as the final model. Calibration of the model was assessed by plotting predicted versus actual probabilities. The model was internally validated using bootstrapping, and externally validated using data from an additional 150 patients from one large academic center and two community-based hospitals.

RESULTS: Predictors included in the final model and nomogram were age, CCI, unilateral versus bilateral procedure, BMI, preoperative anemia, coumadin, and coronary artery disease. The model was used as the basis to create a nomogram. The model demonstrated a bootstrap-corrected C-index of 0.72, as well as acceptable discrimination and calibration. The C-index for the external validation sample was 0.66.

CONCLUSION: This predictive model and nomogram, with a C-index of 0.66 and external validation appears to be accurate. This model may be a useful tool to aid in the prevention of major complications in this vulnerable population.

100. No Difference in 90-Day Complications Between Bilateral Unicompartmental and Total Knee Arthroplasty

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SUMMARY: Simultaneous bilateral unicompartmental knee arthroplasty (UKA) had a similar 90-day complication rate when compared to 2 to 1 bilateral total knee arthroplasty (TKA) matched controls.

INTRODUCTION: UKA has been shown to be less invasive than TKA, but there has been conflicting evidence whether bilateral UKA is a safe practice and its performance is highly surgeon dependent. The purpose of this study was to compare the 90-day complication rates in a select group of patients undergoing simultaneous bilateral UKA when compared to matched controls undergoing bilateral simultaneous TKA.

METHODS: 487 UKA (415 patients) were performed at one institution between 2003 and 2009. Of these, 28 bilateral UKA (56 knees) were performed in 16 males and 12 females with a mean age of 64 ± 9 years. The cases were matched 2-1 to a cohort of 56 bilateral TKA (112 knees) according to age, gender, and American Society of Anesthesiologist (ASA) score. The medical records of these patients were reviewed to identify complications, reoperations, and hospital readmission during the first 90 days after surgery.

RESULTS: The median operative time was 150 (114, 206) minutes for bilateral UKA and 171 (127, 269) for bilateral TKA, and this difference was not significant ($p=0.06$). The mean length of stay was 3.9 ± 1.2 days for bilateral UKA and 5.2 ± 2.1 days for bilateral TKA ($p<0.001$). Ninety-day complications in the UKA group included one wound infection and one DVT (3.57%). There were two complications in the 112 TKA knees and included one superficial wound infection and one pulmonary embolism (1.79%). One knee in each group required irrigation and debridement for wound infection. These were the only two patients that required readmission within 90 days.

CONCLUSION: Unilateral UKA provides a faster recovery and less risk of perioperative complications when compared to unilateral TKA. Despite its lower isolated morbidity, bilateral UKA was found to have similar complications to a group of bilateral TKA patients. Surgeons should use this data to counsel patients undergoing bilateral simultaneous UKA.

101. Assessment of VTE Risk Stratification and Multimodal Thromboprophylaxis in a Joint Replacement Practice

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INTRODUCTION: The ideal method of VTE (venous thromboembolic) prophylaxis following total joint replacement (TJR) remains controversial, driven in part by the presence of competing guidelines published by the ACCP and the AAOS. While the former guidelines assign the same risk to all patients undergoing TJR, the latter approach favors an individualized risk assessment of both postoperative VTE and bleeding for each patient, with the proposal that low risk patients may be appropriately treated with mechanical compression and aspirin. The purpose of this study is to provide results using a risk stratification approach to VTE prophylaxis in joint replacement surgery.

METHODS: 1,286 patients were evaluated and stratified as either low or high risk for postoperative VTE. All patients were treated with a mobile compression device. The addition of pharmacologic treatment (aspirin, LMWH, VKA) was based on a simplified method of VTE risk assessment that has been previously described, with low risk patients receiving ASA and high-risk patients receiving a more potent anticoagulant.

RESULTS: The overall DVT rate was 1.55% and PE rate was 0.23%. Patients correctly stratified into the low risk group who were treated with ASA in addition to compression pumps had a very low rate of both DVT and PE (0.3%). Patients correctly identified as high risk who received a potent anticoagulant also had a very low rate of both DVT and PE. A high DVT rate (9.4%) was identified for patients who were erroneously stratified into the low risk group despite the presence of an identifiable risk factor. A further subgroup of patients with the highest rate of DVT (11.8%) were those anticoagulated for atrial fibrillation.

CONCLUSION: Our data shows the usefulness of the risk stratification model to guide appropriate VTE prophylaxis. When properly implemented, the rate of VTE events was very low.

102. Thromboembolic Risk with Tranexamic Acid After Primary Total Hip and Knee Arthroplasty: Three Prophylactic Regimens

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INTRODUCTION: The use of antifibrinolytics (i.e., tranexamic acid) in total joint arthroplasty has been shown to reduce intraoperative blood loss and decrease transfusion rates post-operatively. As orthopedic surgeons move to different thromboembolic (TE) prevention regimens, a concern remains about their pro-thrombotic potential especially when used with less aggressive TE prophylactic regimens.

METHODS: Patients undergoing primary total hip or knee arthroplasty by three surgeons, each with a different postoperative TE prophylactic regimen, during 2008-2009 were retrospectively reviewed. The three regimens included dalteparin, warfarin, and aspirin. All patients received intraoperative tranexamic acid. Patients were stratified based on their ASA physical status score. Primary outcome measures were thromboembolic events including deep vein thrombosis (DVT), pulmonary embolism (PE), myocardial infarction (MI), and cerebrovascular accident (CVA). Postoperative hematoma rates were also recorded.

RESULTS: A total of 1,497 patients were included in this study with similar number of patients in each regimen. Most patients were ASA score two or three, 1,039 and 378 patients, respectively. The percent risk for any TE complication was 1.2%, 1.13%, and 0.73% for aspirin, warfarin, and dalteparin therapy respectively ($p=0.71$). This did not significantly vary between stratified groups. The risk for DVT was increased at 0.48% for aspirin, and 0.19% and 0.18% for warfarin and dalteparin respectively; however, this was not statistically significant ($p=0.60$). The risk of PE, MI, CVA, and hematoma was not statistically different between groups.

CONCLUSION: Despite the use of less aggressive TE prophylaxis with aspirin, there was no statistically significant increase in TE complications with intraoperative use of tranexamic acid. Physicians may consider the use of tranexamic acid to decrease blood loss and transfusion rates concomitantly with aspirin therapy for TE prophylaxis after primary joint arthroplasty if the patient has no other comorbidities necessitating the use of warfarin or low molecular weight heparin.

103. Characterization of Orthopedic Surgery Patients with a Pulmonary Embolus at a Community Hospital

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INTRODUCTION: A pulmonary embolus (PE) occurs frequently in medical patients and acutely in post surgical total joint patients. While the two groups seem vastly different, there has been no distinction in the pathophysiology of the events in the two groups. We hypothesized that gender and medical co-morbidities would be different in the two groups.

METHODS: We conducted a retrospective chart review at Providence Hospital from 2006 to 2011 of all total hip arthroplasty (THA) and total knee arthroplasty (TKA) patients who had a postoperative PE diagnosis and compared them to medical patients who had a PE as a primary diagnosis. Inclusion criteria for orthopedic patients included THA or TKA performed prior to PE, PE within one month of surgery, and spiral computed tomography (CT) confirming diagnosis of a PE. Exclusion criteria included V/Q scan alone to diagnose the PE. Medical patient's inclusion criterion was positive PE on spiral CT scan.

RESULTS: Of the 2,878 TKAs (2,024 women, 856 men) and 1,270 THAs (749 women, 521 men) patients reviewed, 51 developed a PE. Although 67% of all total joint patients were women, they comprised 92% (n=47) of all PE patients (P <0.0001). Only 58% of the medical patients with a PE were women (P = <0.001). No difference was observed in the average number of comorbidities between orthopedic patients (2.5) and medical patients (3.1) or the most common comorbidities (diabetes, hypertension, and hypercholesterolemia). However, gastroesophageal reflux disease was more common in orthopedic patients (P = 0.003).

CONCLUSIONS: Women undergoing total joint arthroplasty had a significantly higher risk of developing a PE at our institution. These data should be used to aid risk stratification and help guide anti-thrombotic treatment regimens.

104. Demographic and Clinical Predictors of PE Clot Burden

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BACKGROUND: CT angiography is a very sensitive tool for diagnosing PE after TJR. However, there is no clinically related quantitative differentiation of PE clot burden diagnosed by CT angiography, making the clinical relevance of the CT findings unclear. The study set forth to identify demographic and clinical predictors of clot burden as measured by CT angiography.

MATERIALS AND METHODS: From 2004 through 2008, 86 pulmonary emboli occurred in patients undergoing total joint replacement at our institution. Seventy-six had a CT angiogram to diagnose the pulmonary embolus. CT scans were reviewed and graded using a quantitative grading system based on clot burden. The clots were classified based on clot location and status (occlusive or nonocclusive) as described by Qandali, et al. and stratified into five groups. A chart review was performed to assess presenting symptoms in these patients as well as demographics as a predictor for burden. The CT results were then correlated with the clinical presentation and post-diagnosis clinical course.

RESULTS: None of the patients with CT diagnosed PE subsequently died. Twenty-six of the CTs had minimal, 43% had mild, 18% had moderate, 12% had severe, and 0% had massive clot burden. There was no statistical difference between the subgroups with regard to presenting symptoms or demographics.

CONCLUSION: There are no clinical surrogates for clot burden and no demographic predictors for size of clot burden. Therefore, a high clinical suspicion is warranted when evaluating a patient for a PE as seemingly innocuous symptoms may represent large clot burden.

MAOA BREAKOUT SESSION #9
SHOULDER
April 20, 2012

105. Incidence, Complications, and Results of Long Stem Humeral Components in Revision Shoulder Arthroplasty

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INTRODUCTION: Currently, there is little information on the benefits and problems associated with long stem humeral components in shoulder arthroplasty. Therefore, this study was developed to examine the frequency, complications, and results of using a long stem humeral component in revision shoulder arthroplasty.

MATERIALS AND METHODS: From 1976 to 2006, 612 revision shoulder arthroplasties were performed at our institution. Our study group included 82 shoulders with intermediate or long stem humeral components that were followed clinically for at least two years or until repeat revision surgery. The primary indications for revision surgery were loosening of the humeral component in 32, instability in 18, painful hemiarthroplasty in 9, infection in 9, polyethylene wear in 5, acute periprosthetic fracture in 5, and nonunion in 4. The primary indications for use of an intermediate or long stem were proximal bone loss in 42, nonunion in 14, a malpositioned previous stem in 10, an acute intraoperative fracture in 7, and an acute preoperative periprosthetic fracture in 5, distal bone loss in 2, and an osteotomy to remove a well-fixed stem in 2. Fifty-seven of the components were cemented, and bone graft was used in 34 cases.

RESULTS: Intraoperative complications included a fracture removing the previous stem in five, cortical perforation inserting the intermediate or long stem in six, and cement extrusion in seven. Late complications included fracture nonunion in five, deep infection in two, and component loosening in one. Radiolucent lines were identified in 34 cases, but only one component met criteria to be considered radiographically “at risk” for clinical loosening.

DISCUSSION: Intermediate or long stem humeral components are useful in revision shoulder arthroplasty in cases involving significant bone loss, fracture, or a previously malpositioned stem. Caution should be taken to avoid intraoperative fractures distally and cement extrusion. Neither clinical nor radiographic follow-up show these components to be at high risk for loosening.

106. Proinflammatory Cytokines and Proteases in Shoulder Arthroplasty Periprosthetic Tissue

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INTRODUCTION: The purpose of this study was to characterize proinflammatory cytokines (PICs) and matrix metalloproteinases (MMPs) expressed in the tissue surrounding shoulder arthroplasty prostheses at the time of revision and compare total, hemi, and reverse total shoulder arthroplasties to elucidate the effects of articulation conformity and component material composition on cytokine and MMP expression.

METHODS: At the time of revision of 11 TSA, 14 HA, and 3 RTSA systems, waste periprosthetic tissue samples were subjected to multiplex ELISA to quantify concentration of tumor necrosis factor-alpha (TNF-α), interleukin-1beta (IL-1β), interleukin-8 (IL-8), matrix metalloproteinase-2 (MMP-2), matrix metalloproteinase-3 (MMP-3), and matrix metalloproteinase-9 (MMP-9).

RESULTS: For TSA, humeral samples were significantly higher in IL-1β ($p=0.042$) and TNF-α ($p=0.023$) than glenoid samples and glenoid samples were significantly higher in MMP-2 ($p=0.049$) than humeral samples. For HA, humeral samples had significantly higher concentrations of MMP-2 ($p=0.028$) than glenoid samples. When the glenoid tissue samples from HA, TSA, and RTSA were compared, TSA had significantly greater IL-1β expression than HA ($p=0.021$), while HA showed significantly increased IL-8 than RTSA ($p=0.011$). Humeral samples from TSA showed significantly greater IL-1β than RTSA ($p=0.043$). Differences in the MMP expression between HA, TSA, and RTSA tissue samples, both glenoid and humeral, showed no statistical significance.

DISCUSSION: Results show significant differences in PIC concentration between systems with unconstrained (TSA) and semiconstrained (RTSA) articulation, which may be an effect of polyethylene (PE) wear debris size and morphology. A significant difference was also shown between systems with and without a PE component, demonstrating a possible, distinct role of metallic and PE components on the proinflammatory cascade.

107. The Anterior Deltoid's Necessity for Reverse Shoulder Arthroplasty: A Cadaveric Biomechanical Study

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INTRODUCTION: Not infrequently, patients who are candidates for reverse shoulder arthroplasty have had prior surgery that may compromise the anterior deltoid muscle. Recent literature provides diverging accounts of the importance of the anterior deltoid in this population. The purpose of this study was to determine the 3-D moment arms for all deltoid segments, and determine the biomechanical significance of the anterior deltoid before and after reverse shoulder arthroplasty.

METHODS: Eight cadaveric shoulders were evaluated with a 6-axis force/torque sensor to assess the direction of rotation and 3-D moment arms for all six segments of the deltoid both before and after placement of a reverse shoulder prosthesis. The two segments of anterior deltoid were sequentially unloaded to determine their functional role.

RESULTS: The 3-D moment arms of each segment of the deltoid were significantly altered by placement of the reverse shoulder prosthesis. The anterior and middle deltoid abduction moment arms significantly increased after placement of the reverse prosthesis ($p<0.05$ for both). Furthermore, the loss of the anterior deltoid resulted in a significant decrease in both abduction and flexion moment arms ($p<0.05$). When only the inferior portion of anterior deltoid was lost, the remaining deltoid pulled the arm 8.7° into extension. In contrast, when both portions of anterior deltoid were lost, the arm was pulled 20° into extension. The prosthesis did not dislocate even when both anterior deltoid segments were unloaded.

CONCLUSION: The abduction moment arms of the anterior and middle deltoid significantly increased after reverse shoulder arthroplasty placement. The anterior deltoid is important biomechanically for balanced function after a reverse total shoulder arthroplasty. Losing one portion of the anterior deltoid may still allow arm abduction; however, losing both portions of the anterior deltoid may disrupt balanced arm abduction. Surgeons should be cautious about placing reverse shoulder arthroplasty in patients who do not have a functioning anterior deltoid muscle.

108. The Biomechanical Stability of Distal Clavicle Excision vs. Symmetric Acromioclavicular Joint Resection

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INTRODUCTION: The purpose of this study was to determine the strength and stiffness after both distal clavicle excision (DCE) and symmetric acromioclavicular joint resection (ACJR) during simulated physiologic loading.

METHODS: Twenty matched, fresh-frozen human cadaveric shoulders were randomly assigned to one of two groups: DCE (10 mm of distal clavicle, n=10) and ACJR (5 mm of distal clavicle and 5 mm of acromion, n=10). Prior to resection, the stability of each AC joint was tested. Specimens were loaded in the AP plane at 70 N for 10 cycles to determine anteroposterior translation prior to resection and this was repeated after resection. Mean displacement of the Instron was recorded for each specimen. The specimens were then loaded at 2 mm/s in the AP plane until clinical failure which was defined as 15 mm of displacement. Peak load and stiffness were compared using a paired t-test ($p<0.05$).

RESULTS: The peak load to failure for the DCE and ACJR groups was 387.8 N and 468.5 N. The ACJR group was significantly stronger ($p=0.035$). The average stiffness for each group was 35.2 N/mm (DCE) and 37.4 N/mm (ACJR). There was no significant difference in stiffness between the groups ($p=0.11$). There was no significant difference in the anteroposterior translation before and after resection for either group ($p>0.05$).

DISCUSSION: The superior, inferior, anterior, posterior ligaments and capsule of the acromioclavicular joint, along with the coracoclavicular ligaments (conoid and trapezoid), provide it with the vast majority of its stabilizing forces. Both DCE and ACJR can disrupt these crucial structures, leading to a postoperative complication of increased AC joint laxity. In this cadaveric study, symmetric resection of both the clavicle and acromion created a more stable joint than resection of the distal clavicle alone when loaded in an anterior to posterior direction. This is a proof-of-concept study that will lead to a future clinical trial examining the outcomes in patients who receive either surgical treatment.

109. Clinical and Radiographic Factors Influencing the Results of Revision Rotator Cuff Repair

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BACKGROUND: The reported results of revision rotator cuff repair have been mixed, with historically poor results at our institution. We sought to review the results of first-time open revision rotator cuff repair with an analysis of clinical and radiographic risk factors for success or failure.

METHODS: Forty-four patients (45 shoulders) underwent first-time open revision rotator cuff repair between 1995 and 2005 and were reviewed retrospectively with minimum 12 months follow-up. The tears were small in 1 shoulder, medium in 8, large in 24, and massive in 12. Associations of clinical and radiographic factors with the outcomes of pain, elevation, and external rotation were assessed using a Wilcoxon rank sum test.

RESULTS: At average follow-up 6.9 years (range, 12 months to 14.9 years), a satisfactory outcome was the result in 26 shoulders (57%). An excellent result was achieved in 2 shoulders (4%), a good result in 9 (20%), a fair result in 15 (33%), and a poor result in 19 (42%). The only factor associated with a satisfactory outcome was greater preoperative elevation (142 vs. 90°, p=0.008). Postoperative pain decreased to median 5.0 from preoperative median 8.0 (p=0.002); however, neither postoperative range of motion in elevation nor external rotation were significantly increased after revision. Greater postoperative elevation and external rotation was associated with absence of glenohumeral arthrosis preoperatively (p=0.039, p=0.013).

CONCLUSIONS: Revision rotator cuff repair continues to have a large number of unsatisfactory results at our institution. Patients should be counseled regarding reliable relief of pain with revision, but on the unpredictability of overall outcome. For patients with certain risk factors for failure, consideration should be given to alternative treatment options, such as reverse total shoulder arthroplasty.

110. Relationship of Rotator Cable Tears to Increases in Rotator Cuff Strain in a Novel Cadaveric Shoulder Model

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BACKGROUND: Anterior tears of the supraspinatus are more likely to result in fatty degeneration than posterior tears of the supraspinatus (Keener et al, JBJS 2010). We hypothesize that this finding may be related to a lesser load bearing role for the rotator crescent region of the posterior supraspinatus and a primary load bearing role for the rotator cable suspension bridge construct (Burkhart et al, Arthroscopy 1993).

METHODS: Cadaveric shoulders were randomized to undergo equivalent sized supraspinatus tears of either the anterior rotator cable (n=5) or the adjacent rotator crescent (n=5). For each shoulder, the supraspinatus was cycled (displacement control) five times from 10N to 180N, first in the intact and then the cut conditions. The von Mises strain was determined in nine regions of the intact and cut supraspinatus tendon at 180N of the respective fifth cycle. A custom 3D optical system was used to track regional displacements and compute strains (repeatability ≤ 0.02 strain). For each shoulder, a paired t-test was used to compare regional strain between the intact and cut conditions ($p \leq 0.05$ considered significant).

RESULTS: Regional strains in the intact supraspinatus tendon averaged 0.04 ± 0.02 at 180N of load. After a tear of the anterior cable, the strain in the footprint adjacent to the tear averaged 0.08 ± 0.04 (+78%; p=0.03), and the strain in the posterior medial tendon averaged 0.10 ± 0.04 (+77%; p=0.02). For an equivalent-sized tear of the rotator crescent, the strain in the both the footprint adjacent to the tear and the posterior medial tendon averaged 0.04 ± 0.02, which was not significantly different than the strain in these regions when the tendon was intact.

DISCUSSION: This study demonstrates that tears of the rotator cable result in increased strain in the adjacent footprint and the posterior medial rotator cuff. In contrast, tears of the rotator crescent do not have these consequences, potentially due to stress shielding by the cable.

CLINICAL RELEVANCE: Rotator cable tears (anterior supraspinatus) have a biomechanically different consequence compared to equivalent size tears of the rotator crescent (posterior supraspinatus).

111. Effect of Lesser Tuberosity Osteotomy Repair Technique on Gap Formation Compared to Subscapularis Tenotomy Repair During Total Shoulder Arthroplasty♦

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BACKGROUND: Subscapularis dysfunction after total shoulder arthroplasty (TSA) remains a devastating complication. Attempts to improve postoperative subscapularis healing and integrity include lesser tuberosity osteotomy with multiple methods of repair. Recent biomechanical and clinical results suggest the superiority of osteotomy over subscapularis tenotomy; however, significant disagreement over the best repair technique remains.

PURPOSE: To characterize the strength of a new repair technique using cable fixation to promote lesser tuberosity healing compared to standard tenotomy and dual row repair of a "fleck" lesser tuberosity osteotomy during TSA.

METHODS: Ten fresh-frozen cadavers were dissected down to humeri and attached subscapularis myotendinous unit. Shoulders were then separated into three test groups. Group I underwent standard subscapularis tenotomy and repair with four #2 Fiberwire tendon-to-tendon sutures using a modified Mason-Allen technique. Group II underwent a "fleck" osteotomy repaired with a dual row of four #2 Fiberwire sutures as described by Krishnan et al. Group III underwent lesser tuberosity osteotomy repair using low profile tensioned 1 mm braided titanium cable and four #2 Fiberwire sutures passed through bone tunnels. Gapping along the repair for each specimen was then digitally measured during cyclical loading and load-to-failure.

RESULTS: Ultimate failure loads for tenotomy repair, dual row osteotomy repair, and cable osteotomy repair were 270±72N, 334±119N, and 336±218N, respectively. The repair most resistant to gapping was the cable and suture technique followed by the dual row repair and then the tenotomy repair.

CONCLUSION: The cable osteotomy repair technique is the most resistant to gapping in our initial testing. Further testing is underway to increase sample size in each group. Better resistance to initial repair gapping may allow for improved healing and postoperative integrity of the subscapularis tendon after TSA.

112. Evaluating a New Assessment Method for Posterior Humeral Head Subluxation and Glenoid Retroversion in Glenohumeral Osteoarthritis

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BACKGROUND: Outcomes of shoulder arthroplasty have been reported to be worse in the setting of posterior glenoid wear (PGW) and posterior subluxation of the humeral head (PSH). The current Walch classification system for glenohumeral OA has poor reliability and may not truly characterize this relationship. The purpose of our study was to evaluate a new assessment method for PSH and establish a better understanding of the relationship between PSH and PGW.

MATERIALS AND METHODS: Thirty-three patients who underwent a total shoulder arthroplasty (TSA) were evaluated by 3D preoperative CT simulations. Average measured glenoid retroversion was -22°, average humeral head subluxation (HHS) in the AP plane was -9.71 mm with an average posterior offset of -37.9%. Percent was calculated based on amount of offset in relation to size of the humeral head.

RESULTS: A very strong positive linear correlation existed between glenoid retroversion and HHS in AP offset (R^2=0.805, p<0.001) and HHS percentage in the AP offset (R^2=0.859, p<0.001). Independent Walch correlations to glenoid retroversion (R^2 =0.714, p<0.001), HHS in AP offset (R^2 =0.650, p<0.001), and HHS percentage in AP offset (R^2 =0.638, p<0.001) were not as strong.

DISCUSSION: Our results demonstrate a direct linear relationship between HHS and glenoid retroversion. Neither 3D measured glenoid retroversion or HHS had a strong correlation with the current Walch classification. Awareness that amount of PSH may be directly related retroversion should be recognized for preoperative planning and when counseling patients with regard to expected outcomes.

113. A Comparison of Cartilage and Subchondral Bone Characteristics Between the Glenoid and Humeral Head

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INTRODUCTION: Different articular cartilage injury and degenerative patterns exist between the glenoid (GL) and humeral head (HH). This study utilized histologic, tomographic, and biomechanical analyses to assess differences in cartilage and subchondral bone geometry and biomechanics of the HH and GL.

METHODS: Ten human glenohumeral joints (mean 60.2 yrs) were dissected to expose articular surfaces. A 2 mm (for histology) and 6 mm (biomechanical testing, microCT) osteochondral plug was harvested at each of five intra-articular zones (Center, Anterior, Posterior, Inferior, Superior). H&E-stained sections were imaged and seven thickness measurements of articular cartilage were taken using light microscopy. Subchondral bone thicknesses of the same five zones were measured on images obtained with micro CT. Articular cartilage specimens were removed from subchondral bone and tested in confined compression at 5% strain increments (0-50%). Stress values were calculated and used to solve for the aggregate compressive modulus and stiffening coefficient using Van Mow's inhomogenous finite deformation biphasic model. Nanoindentation was used to indent subchondral bone at 6 mN for 180 s to derive elastic modulus, hardness, creep rate, and dissipated energy.

RESULTS: The GL has significantly thicker articular cartilage (2146.74 μm, n=44) than the HH (1420.20 μm, n=50) ($p<0.001$). The mean thickness of subchondral bone of the GL (938.41 μm, n=49) is significantly higher than the subchondral bone of the HH (823.72 μm, n=48) ($p<0.001$). There is no significant difference in the aggregate compressive modulus or stiffening coefficient of articular cartilage. There is no statistical difference in the elastic modulus, hardness, creep rate, or dissipated energy of subchondral bone.

CONCLUSIONS: While the glenoid has significantly thicker articular cartilage and subchondral bone, no biomechanical differences were found in cartilage or subchondral bone. This suggests that anatomical differences, not biomechanical properties, may explain differences seen in glenohumeral joint degeneration. This finding could influence further development of resurfacing and arthroplasty constructs.

114. Outcome Following Early Open Reduction and Internal Fixation of Proximal Humeral Head-Split Fractures

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PURPOSE: This case series evaluates the efficacy and short-term clinical and functional outcomes internal fixation treatment of humeral head-splitting fractures.

METHODS: From 2002 through 2006, seven patients with proximal humeral head-splitting fractures were operatively treated at a Level 1 teaching trauma center. Documented CT scan confirmed a humeral head-splitting fracture. Patient function was assessed with serial physical examinations and subjective outcome scores using the Short Musculoskeletal Function Assessment (SMFA) score, Disabilities of the Arm, Shoulder, and Hand (DASH) score, and the Short Form (SF-36) Health Survey.

RESULTS: Gender was predominately male (five males, two females) with an average age of 52 years (29-75). The mechanism of injury was high-energy (4) and low-energy falls (3). Fracture classifications were Neer (3-part, 3- and 4-part, 4) and all OTA/AO 11C2.3 fracture patterns. Average ROM was 154° FF, 41° ER, and 47° IR. Six of seven (85.7%) patients achieved uncomplicated radiographic union; while one fracture developed post-traumatic AVN and collapse revised to arthroplasty at one year. Four of the seven (57.1%) patients benefited from manipulation and hardware removal secondary to arthrofibrosis and impingement. The DASH score averaged 29.3 (1-54) and was significantly worse among those patients with a high energy (43.3) compared to low-energy (8.3) fractures ($p=0.04$). SMFA arm/hand functional outcome measurement required one year to plateau (Arm/Hand was 22.9, 11.9, and 10.9 at 6, 12 and 24 months respectively). Age and mechanism of injury did not relate to different functional outcomes. SF-36 measurements plateaued at one year. Of previously employed workers, four of five patients returned to functional employment.

CONCLUSIONS: This series shows similar outcomes at two years when compared with standard 3- and 4-part proximal humeral fractures. An attempt at head preserving surgery should be made in the young patient for whom reasonable results can likely be expected.

115. Accuracy and Reliability Testing of Two Methods for Measuring Internal Rotation of the Glenohumeral Joint

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INTRODUCTION: Clinical studies commonly report measurements of glenohumeral range of motion to demonstrate improvements following intervention. Measurements for internal rotation have traditionally been estimated as the most cephalad spinous process that the patient can reach behind his/her back. We propose to compare this method with another where the shoulder is placed in abduction and then internally rotated by the examiner. The resulting measurement can be made in degrees and confirmed with a goniometer. We hypothesized that there would be no difference in accuracy or reliability between the two methods.

METHODS AND MATERIALS: Fifty healthy volunteers between 18-65 years of age were recruited. Patients with prior shoulder surgery, symptomatic shoulder pain, prior thoracic or lumbar spine surgery, and women of child-bearing age were excluded. Six blinded faculty observers specializing in the treatment of shoulder disorders comprised a pool of evaluators to make estimations of glenohumeral internal rotation. For each patient, three observers were randomly chosen to make estimates.

Patients first had their hand placed in a random position behind their back by an independent observer. Three faculty observers then estimated the most cephalad spinous process reached by the patient's thumb. With the hand in the same position, a single lateral scoliosis x-ray was obtained. The independent observer then radiographically assessed the spinous process reached by the patient's thumb.

The independent observer then placed the patient’s arm in 90° of abduction, internally rotated the shoulder to a random position while stabilizing the scapula, and measured the amount of internal rotation with a goniometer. The same three blinded faculty observers then estimated the number of degrees of internal rotation. This process was repeated for a second time after a minimum of ten minutes and after multiple other estimates had been made to other patients by the blinded observers to minimize recall bias.

Statistical analysis for inter-observer reliability and accuracy were calculated using intra-class coefficients (ICC) with 95% confidence intervals. Intra-observer reliability was calculated using the Spearman correlation coefficient with 95% confidence intervals. ICCs greater than 0.8 were considered to have near-perfect agreement while ICCs between 0.6-0.8 were considered to have good agreement. (CITE)

RESULTS: ICC for estimation of spinous process level averaged 0.75 (range 0.62-0.94) indicating good agreement among observers. Ninety-five percent confidence intervals placed estimates 1.0-2.0 spinous levels different from the objective (x-ray) measure.

ICC for estimation of internal rotation with arm in abduction averaged 0.81 (range 0.7-0.91) indicating near-perfect agreement among observers. Ninety-five percent confidence intervals indicated estimates differed 6.0-11.4° from the objective (goniometer) measure.

Spearman correlation coefficients of intra-observer reliability for estimates of internal rotation with the arm in abduction averaged 0.94 (range 0.89-0.96), indicating near-perfect agreement within observers. Ninety-five percent confidence intervals demonstrate that repeat estimates were between 5.2°-9.4° of the original.

CONCLUSIONS: Estimation of spinous process level for measuring internal rotation of the shoulder demonstrates good inter-observer reliability among trained observers. However, estimation in degrees is more reliable with near-perfect agreement between observers. Intra-observer reliability of this estimation is also near-perfect and is accurate to within 10° of the original. Despite this agreement data, 95% confidence intervals suggest that these estimates for measuring internal rotation of the shoulder are imprecise. We recommend objective measurement using a goniometer with the arm in abduction. If estimates of this measure are to be made, degree estimates with the arm in abduction have higher inter-observer reliability than those of spinous process level and demonstrate excellent intra-observer reliability.

MAOA BREAKOUT SESSION #10
FOOT AND ANKLE
April 20, 2012

116. Open vs. Percutaneous Fixation of Joint Depression, Tongue-Type, and Partial Tongue-Type Calcaneus Fractures

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INTRODUCTION: Several authors have described percutaneous reduction of tongue-type and joint depression fractures of the calcaneus. The purpose of this study was to compare the radiographic outcomes and clinical complication rates for a single surgeon treating both types of fractures. In addition, we describe a third type of fracture, the partial tongue-type, in which the calcaneal tuberosity is contiguous with a variable portion of the posterior facet. To our knowledge, a rigorous discussion of the partial tongue-type fracture has not been reported in the English literature.

METHODS: Radiographs and hospital charts of all patients with calcaneus fractures treated by either ORIF or percutaneous reduction by a single surgeon at a level 1 trauma center were retrospectively reviewed from 2007 to 2010. Radiographic and clinical examination findings were recorded.

RESULTS: Sixty-one patients were treated with either percutaneous screw fixation (36) or ORIF (25) using a standard Benirschke-style extensile incision. Mean follow-up was 13 months. There were comparable numbers of different fracture types in each treatment group. The average loss of Bohler's angle with time was 7° for ORIF versus 4° for percutaneous. Length and width did not differ between the percutaneous and ORIF groups. There were four superficial and two deep infections in the ORIF group compared with one deep infection in the percutaneous group. Twenty-eight percent of patients had nerve complications, similarly divided between the two groups. The percutaneous group had higher rates of post-traumatic arthritis (31% vs. 20%) and hardware removal (28% vs. 8%) compared to ORIF. Regardless of type of treatment, partial tongue-type fractures appeared to have intermediate radiographic results between joint depression and tongue-type fractures.

DISCUSSION: Percutaneous treatment of calcaneus fractures predictably has a lower infection rate than ORIF and similar radiographic outcomes to ORIF, as noted in previous literature. However, in this series percutaneous treatment also had a higher reoperation and post-traumatic arthritis rate.

117. Anteromedial vs. Anterolateral Approaches for Pilon Fractures: A Comparison of Complications and Functional Outcomes

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PURPOSE: Compare the rate and severity of complications, and functional outcomes between the anterolateral (AL) and anteromedial (AM) surgical approach used for open reduction and internal fixation of pilon fractures.

METHODS: An IRB-approved medical record review of all operative pilon fractures managed using the anterolateral and anteromedial surgical approach between August 2005 and July 2009 was performed. Eighty-two patients were identified. Rates of complications at final follow-up were determined. Phone interviews were performed to obtain MFA and Foot Function Index scores after final follow-up.

RESULTS: Complete data was available for 79 patients--anterolateral approach (N=42), anteromedial (N=33), and combined anteromedial and anterolateral (N=4). All AL fractures were AO/OTA C fractures and approximately 40% were open. At final follow-up: AM group had the highest number of secondary surgeries (2.48 average vs. 1.5 for AL and AL/AM), and amputations (12% vs. 9.5 AL vs. 0 AL/AM). The combined AL/AM approaches had the longest interval to radiographic healing (451 days vs. 294 AM vs.190 AL). Functional outcome data was available for 39 patients (AL 23 patients, AM 14 patients, AL/AM 2 patients). The average fracture classification for each group was AO/OTA C2-3 AL, B3-C1 AM, and C2-3 AL/AM. Time to outcome evaluation from injury was 1,197 days AL, 1,294 days AM, and 1,223 days AL/AM. The average MFA scores were 40 AL/AM, 35.3 AL, and 32.6 AM. The average FFI scores were 57.2 AL/AM, 45.6 AL, and 42.1 AM.

DISCUSSION: Pilon fractures significantly affect patient function. Complications and functional outcomes of pilon fractures undergoing ORIF revealed that the AL and combined AL/AM groups had more complex fractures but fewer secondary procedures, and better outcomes scores when compared to the AM approach. The combined AL/AM group had the longest time to radiographic healing. When compared to the anteromedial approach, the anterolateral approach appears to result in fewer complications despite being used for more complex fractures.

118. Outcome of Patients Following Calcaneus Fractures: Will Life Ever Be the Same?

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PURPOSE: The purpose of our study is to report mid-term follow-up of operatively treated calcaneus fractures using validated outcome measures after adequate time for healing and recovery to determine return to work and function.

METHODS: The inclusion criteria included all intra-articular calcaneus fractures with surgical fixation. Exclusion criteria were any ipsilateral or contralateral periarticular lower extremity fractures. The patients were followed up with a physical examination and administration of functional outcomes measures including the SF-36 and American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hind foot score, evaluation for post-traumatic stress (PTSD), and current activity and work status. Statistical analysis was completed with a $p<0.05$ considered significant.

RESULTS: Twenty patients were enrolled in the study, with 5 patients with bilateral injuries and 15 with unilateral injuries (25 fractures). There were 16 males and 4 females with an average age at injury of 42 years (range: 16-73). The average follow-up time was 34 months (range: 13-73). Forty percent of patients reported a change/decrease in their work/school status due to their injury. Eighty-five percent reported a decrease in ability to participate in recreational activities. Seventy-five percent reported change in footwear, and 35% reported use of assistive ambulatory devices. Twenty-five percent responded “Yes” to a PTSD screening question. The average AOFAS score was 68. The SF-36 results indicated lower scores in all domains compared to the general population. There was no significant difference between unilateral and bilateral fractures with AOFAS score or SF-36 scores.

CONCLUSION: Operative fixation of the calcaneus is designed to restore articular and axial hindfoot alignment and restore tenets of gait mechanics. However, achievement of these variables has a modest correlation with mid-term patient outcome in this study. In particular, patients sustaining bilateral fractures performed no worse psychologically and in function than unilateral injury patients. Clinicians need to counsel patients regarding the practical outcomes of a calcaneus fracture: life after this injury may never be the same.

119. Correlation of Knee and Hindfoot Deformities in Patients with Advanced Knee Arthritis

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BACKGROUND: Synchronous interaction between the joints of the lower extremity is essential for proper gait. Since the relationship between knee and hindfoot alignment is unclear, this study was completed to investigate and elucidate the relationship between knee deformity and corresponding hindfoot alignment.

METHODS: 401 TKAs in 324 patients were evaluated. Standing full-leg-length anteroposterior and Saltzman hindfoot alignment view radiographs were used to determine the mechanical axis angle and the degree of hindfoot malalignment using the Saltzman measurement and the Saltzman hindfoot angle. The relationship between knee deformity and hindfoot alignment was assessed for linear correlation. Intra-class correlation coefficient was used to evaluate intra- and interobserver reliability.

RESULTS: The mechanical axis angle correlated with both the Saltzman hindfoot measurement and the Saltzman hindfoot angle in the entire cohort (p-value = 0.0001). The difference in hindfoot alignment between knees with varus and valgus deformity were significant in the entire cohort and the ≥ 10° knee deformity sub-group (p-value = 0.0001). Intra- and interobserver reliability analysis showed excellent reliability in all measurements.

CONCLUSIONS: This study found significant correlation between knee and hindfoot deformities in patients with advanced knee arthritis and ≥ 10° knee deformity. Patients with a varus knee tend to have a valgus hindfoot and patients with a valgus knee tend to have a varus hindfoot. Complete understanding of the limb malalignment and corresponding deformities can be helpful to surgeons treating patients with advanced knee arthritis with or without foot and ankle problems.

120. Functional Outcomes After Ankle Arthrodesis in Elderly Patients

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Ankle arthrodesis has long been the gold standard of operative treatment for ankle arthritis refractory to non-operative treatment. While multiple studies have documented outcomes after ankle fusion, none have looked specifically at outcomes in elderly patients. We reviewed the rates of fusion, postoperative complications, and overall subjective functional outcomes in this patient population.

We retrospectively identified 30 consecutive patients over the age of 70 treated with isolated ankle fusion between January 1, 1999, and December 31, 2004. Medical records were studied paying attention to the diagnosis, type of fixation, medical comorbidities, and postoperative complications. The Foot and Ankle Ability Measure (FAAM) and American Foot and Ankle Society Hindfoot Score (AOFAS) were used to assess functional outcomes.

We identified 30 patients (30 ankles) over the age of 70 who had undergone ankle fusion with an average age of 74.5 years (+/- 3.7). Seven patients were deceased at final follow-up. Average radiographic follow-up was 2.17 years. Union was achieved in 27 of 30 ankles (90%) with an average time to union of 17.81 +/- 8.08 weeks. Postoperative radiographs showed 11 (36.6%) patients who had progression of their subtalar arthritis.

The average postoperative FAAM score was 81.47 (+/- 18.3) with an average follow-up of 8.5 years (+/-1.7). The average AOFAS hindfoot score was 73.0 (+/- 11.5). Complications included nonunion, deep infection, and adjacent joint arthritis.

In our clinical cohort, we found ankle fusion to be effective in the treatment of ankle arthritis. While total ankle arthroplasty is becoming increasingly popular, ankle arthrodesis is an effective surgical treatment option in an elderly patient population.

121. Valgus Tilting of the Ankle After Hindfoot Fusion: Is it a Long-Term Problem?

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INTRODUCTION: In 1995, the senior author reported his experience with valgus tilting of the ankle in several patients after hindfoot fusion for flatfoot deformity. This observation had also been noted by other authors. The cause was thought to be secondary to inadequate correction of the valgus deformity or development of chronic deltoid ligament insufficiency due to the long-standing hindfoot valgus. What was unclear was the long-term consequence of this malalignment. The purpose of this study was to review those patients 17 years after the original study was presented, to determine their long-term morbidity including the necessity for further surgery, and to present examples of newer case experienced by the other authors.

MATERIALS AND METHODS: A combination of chart review and direct contact with the patient was used to perform this study. Of the six patients in the original article, five were still alive. Inclusion into this study required patients who underwent a hindfoot fusion and had a standing AP radiograph of the ankle after fusion that showed valgus tilting of the ankle. Contact with the spouse of the one patient who had died gave us adequate follow-up. An additional five more recent patients seen by the other authors were also reviewed. Endpoint was established as the presence or absence of ankle fusion or death.

RESULTS: Of the original six patients, only one patient underwent ipsilateral ankle fusion secondary to failure of conservative management. All the rest of the patients expressed satisfaction with their result. One patient was deceased at the time of follow-up; however, absence of further surgery and a good clinical result was confirmed through the surviving spouse. The more recent cases also have had a similar result in the short term.

CONCLUSIONS: The occurrence of valgus tilting of the ankle after hindfoot fusion surgery may be more common than expected. The concern over development of subsequent ankle arthritis, though worrisome, appears to be much less frequent than expected.

122. Proximal Oblique Sliding Closing Wedge Osteotomy in Wide Angled Bunions: A Retrospective Study to Evaluate Radiological and Clinical Outcomes in 70 Patients

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BACKGROUND: The Proximal Oblique Sliding Closing Wedge Osteotomy (POSCOW) technique was developed to address the moderate to severe hallux valgus deformity. POSCOW corrects the intermetatarsal angle by both lateral translation and rotation of the metatarsal head. In this way, it lessens the amount of rotation needed to create parallelism of the first and second metatarsals and decreases the likelihood of creating a DMAA with the articular surfaces in valgus. Secondly, the osteotomy tends to shorten the first metatarsal length which decreases the tension on the first MTP joint easing the ability to correct the alignment. The oblique osteotomy, however, minimizes the shortening caused by the lateral closing wedge and any potential negative effect of the shortening osteotomy. We present a retrospective study to present the radiological and clinical outcomes of 70 patients who underwent this procedure at our institution and a review of literature to compare our results with other types of proximal metatarsal osteotomies.

MATERIALS AND METHODS: Seventy patients (77 feet) were operated between June 2006 and June 2010 by the same surgeon. The mean age was 55.7 (range, 14-80 years). The mean follow up was 33.6 (range, 12-55) months.

RESULTS: The patient satisfaction rate is 87%. The mean preoperative HV angle was 35.75° (range, 24°-55°), and postoperative mean was 11.62° (range -13° to 43°). The mean preoperative IM I—II angle was 14.55° (range, 5° to 27°), and the mean postoperative angle was 3.19° (range -7° to 13°). Therefore, the mean decrease in the HV angle and IM I—II angle were 24.04° and 11.46°, respectively. The mean preoperative length of the first metatarsal was 60.34 mm, and the mean postoperative length was 58.79 mm with a mean decrease in the first metatarsal length of 1.55 mm. The preoperative AOFAS score was 58.09 (range, 35-75), and the postoperative score was 85 (range, 25-100) ($p < 0.005$).

Seven feet (9%) developed a mild recurrence of hallux valgus deformity requiring no treatment and in six feet (7.7%) severe recurrence of the deformity developed, requiring revision surgeries. Three feet (3.8%) developed mild hallux varus, but were asymptomatic. One (1.2%) of them had nonunion, recurrence, and infection requiring revision. One (1.2%) had failed fixation. All patients did well within six weeks of revision surgery. Two (2.4%) patients had delayed union. Removal of complete or partial hardware was needed in 13 (16.8%) for hardware irritation. There was one (1.2%) incidence of broken screw which was removed. No (0%) evidence of malunions noted. Transfer metatarsalgia was noted in two (2.4 %). However, it is very difficult to attribute this to the POSCOW technique as most of the people had concomitant procedures.

CONCLUSIONS: The results of the current study indicated that this combined procedure is an effective and reliable method for relieving pain and improving function regardless of the severity of the hallux valgus deformity (moderate and severe deformity).

123. Medial Joint Space Widening of the Ankle in Displaced Tillaux and Triplane Fractures in Children

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OBJECTIVES: Tillaux and triplane fractures occur in children predominantly from external rotation mechanism. We hypothesized that in displaced fractures, the talus would shift laterally along with the distal fibula and the distal tibial epiphyseal fragment increasing the medial joint space.

DESIGN: Consecutive cases evaluated retrospectively.

SETTING: Level 1 and Level 2 centers.

PATIENTS: Twenty-two skeletally immature patients with 14 displaced triplane fractures and 8 displaced Tillaux fractures were evaluated for medial joint space widening.

INTERVENTION: Measurement of fracture displacement and medial joint space widening before and after intervention.

RESULTS: Thirteen triplane and six Tillaux fractures (86%) showed medial space widening of 1-9 mm and equal to the amount of fracture displacement. Reduction of the fracture reduced the medial space to normal. There were no known complications.

CONCLUSIONS: Medial space widening of the ankle may be a sign of ankle fracture displacement. Anatomic reduction of the fracture reduces the medial space and may improve the results in Tillaux and triplane fractures.

124. Computed Tomography Pilon Classification System

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BACKGROUND: Fracture classification systems are frequently used in orthopedic research and clinical practice. However, there is no universally accepted system for pilon fractures. Several systems have been presented with only moderate reproducibility.

OBJECTIVE: The aim of this study was to produce a classification system with use of computed tomography for pilon fractures and measure its interobserver and intraobserver reproducibility. Furthermore, the classification system presented in this study was compared with postoperative joint congruency and fracture reduction on plain x-ray.

METHODS: Sixty-seven CT scans of pilon fractures were evaluated by an orthopedic traumatologist, an orthopedic surgery resident, and a research fellow. Fractures were classified into three groups based on the number of fragments seen on the axial CT image at the level of the joint. Observers evaluated and graded immediate postoperative x-rays as well. Assessments were performed on two different occasions at least 24 hours apart. The kappa coefficient of agreement was calculated for interobserver and intraobserver reproducibility for all categories. Categorical data was analyzed for relationships using Pearson chi-squared technique.

RESULTS: Intraobserver reproducibility for *Fragment Classification* showed substantial agreement for all three observers. However, only moderate agreement was noted for interobserver kappa values. Pearson chi-squared results showed significance between *Fragment Classification* and *Joint Congruency* as well as *Comminution* and *Joint Congruency*.

CONCLUSION: Current pilon classification systems have only shown moderate agreement. Our classification shows similar results. Further investigation with more observers of similar experience may provide different results of reproducibility. Furthermore, investigation of this system with functional results may provide valuable clinical data.

125. Gastrocnemius Recession for Chronic Achilles Tendinopathy: A Retrospective Analysis of Outcomes

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BACKGROUND: In patients with chronic Achilles tendinopathy, several operative techniques have been described for treatment. A case report has shown that gastrocnemius recession as treatment can normalize MRI findings and relieve clinical symptoms consistent with chronic Achilles tendinopathy. The purpose of this study was to present the results of the treatment of chronic Achilles tendinopathy with gastrocnemius recession.

METHODS: Eight of 12 patients (seven females, one male) who underwent gastrocnemius recession for refractory Achilles tendinopathy between July 2004 and January 2009 were available for follow-up. All patients filled out a SF-36 health survey, a foot function index, an AOFAS ankle and hindfoot scale, and a simple survey formulated by our group of investigators. Seven of the eight patients were available to return for clinical assessment including range of motion, measurement of calf circumference, and strength testing via single-leg toe raises.

RESULTS: The patients had an average age of 49.9 years (SD 11.6) at the time of surgery and average time to follow-up was 34.6 months (SD 18.1) postoperatively. The mean pain score (VAS 0-10 scale) was significantly decreased from 7.3 (SD 1.7) preoperatively to 1 (SD 1.8) postoperatively at the time of follow-up ($p < 0.001$). The mean AOFAS ankle and hindfoot score was 94.4 (SD 9.8), which was significantly improved when compared with previously published scores for patients who underwent Achilles debridement with FHL transfer (p 0.007). All eight categories on the SF-36 health survey showed no significant difference with published data for United States population normative values and previously published data for patients who underwent FHL transfer. All patients reported being satisfied with the procedure and that they would undergo the procedure again.

CONCLUSION: Gastrocnemius recession for the treatment of refractory Achilles tendinopathy is a viable treatment option following the failure of nonoperative management. All eight of our patients had excellent pain relief, good clinical outcome, and were satisfied at the time of follow-up.

126. Treatment of Achilles Tendinopathy Using Ultrasound Stimulation

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George B. Holmes, M.D. Chicago, IL

INTRODUCTION/PURPOSE: Symptomatic Achilles tendinopathy is a localized degenerative process of the tendon commonly associated with diminished vascularity, microtrauma, and aging. Nonoperative treatment consists of activity modification, anti-inflammatory medications, immobilization, splints, and physical therapy. Only 70-75% of these patients respond to these initial conservative modalities. Ultrasound stimulation therapy may provide an additional non-operative method of managing chronic Achilles tendinopathy, particularly for those 25% of patients unresponsive to other nonoperative therapies. The purpose of this study was to determine the short-term clinical outcomes of ultrasound stimulation treatment for refractory Achilles tendinopathy.

MATERIALS AND METHODS: All cases of Achilles tendinopathy treated with ultrasound stimulation were reviewed from one surgeon (GBH) at Rush University Medical Center between 2007-2011. Criteria for use of the device included failure of previous nonoperative therapies including non-steroidal anti-inflammatories, immobilization, night splints, and ankle-foot orthoses. No patients had undergone prior surgery for Achilles tendon pathology. Patients had previously failed nonoperative treatment prior to using the ultrasound bone-stimulation device (Exogen, Smith & Nephew, Memphis, TN) for 20 minutes/day for two months. Routine follow-up examinations were performed at monthly intervals after initiation of treatment. Clinical parameters examined included pain and functional status obtained through patient interview and physical exam.

RESULTS: A total of 15 cases of Achilles tendinopathy were treated with ultrasound stimulation. Average age was 50 years (range, 30-70) with five females and ten males. The right side was affected in three patients, left side in ten patients, and bilaterally in two patients. All patients had serial clinical exams with an average follow-up of 5 months (range, 2-12). Clinical outcomes were based upon pain status and patient reported functional status on follow-up exams.

Excellent clinical outcome was obtained in six patients (40%). Three patients (20%) had good results, and six patients (40%) had minimal benefit with ultrasound therapy. No patient had worsening pain or progression functional disability. Three of the six patients with minimal benefit went on to undergo surgical reconstruction.

CONCLUSIONS: Ultrasound stimulation therapy may be an additional method of managing chronic Achilles tendinopathy that is noninvasive, easy to use, well-tolerated, and relatively inexpensive compared with surgical reconstruction of the tendon. This study demonstrated that 60% of patients had good to excellent relief of Achilles pain and improvement in function using ultrasound stimulation therapy. Short-term results show significant improvement in pain and functional status without any adverse reactions or complications. It is hoped that this initial examination will stimulate more rigorous clinical analyses of the short-term and long-term efficacy of ultrasound stimulation for the treatment of Achilles tendinopathy.

MAOA THIRD PLENARY SESSION
April 21, 2012

127. Complications of Volar Locked Plating for Distal Radius Fractures

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INTRODUCTION: The purpose of our study was to evaluate the incidence and characterize the types of complications that occur with locked volar plating of distal radius fractures at one institution.

METHODS: We retrospectively reviewed the records of 153 randomly selected adult patients with distal radius fractures treated by volar locked plating at one institution from 2001-2009. We identified those patients with minor or major complications. Major complications included hardware-related problems (intra-articular, loosening, pain), tendon rupture or irritation, carpal tunnel syndrome requiring release, infection requiring reoperation, major medical complications, and nonunion. We identified all other complications as minor complications.

RESULTS: There were 16 major and 27 minor complications for a total of 43 complications (28%). The breakdown of complications is seen in Figure 1. Of the 43 patients with complications, 14 underwent further surgery which included 6 limited or full hardware removal, 1 extensor pollicus longus (EPL) reconstruction, 1 EPL rerouting, 1 open carpal tunnel release, 1 trigger finger release, and 1 pin removal. One patient had a Darrach procedure and carpal tunnel release followed by plate removal. Two patients had triangular fibrocartilage complex reconstructions in addition to plate removal. Two patients had intra-articular hardware, but declined surgery for removal as they were asymptomatic.

CONCLUSION/DISCUSSION: The incidence of complications in this study was 43/153 or 28%. The most common complication seen in our series of patients was sensory disturbances (17/43) followed by hardware-related problems (9/43). All but two patients had resolution of their sensory disturbances at the time of final follow-up. Tendon-related complications accounted for 4/43 of the total complications. While many of the complications we reported were minor, there was still a relatively high rate of secondary operations (14/153 or 9%). Interestingly, there were no flexor tendon ruptures/irritation as has been documented by others as a complication of volar plating.

SUMMARY: We found 43 complications in 153 patients treated with volar locked plating for distal radius fractures at one institution. Most complications were minor; however, 14 patients required further surgery.

Figure 1: Complications by Category

Major Complications = 16		
Hardware-related		
	intra-articular	**3**
	loosening	**2**
	pain	**4**
Tendon-related		
	EPL rupture	**1**
	EPL irritation	**3**
Carpal tunnel syndrome requiring surgery		**2**
Nonunion		**0**
Infection requiring re-operation		**0**
Major medical		
	saddle pulmonary embolism	**1**
Minor Complications = 27		
CRPS		**2**
Delayed union		**1**
Sensory disturbances		
	Median nerve	**8**
	Superficial branch radial nerve	**3**
	Other	**6**
Superficial wound infection treated with antibiotics		**2**
Transient distal radioulnar joint (DRUJ) instability		**1**
Stiffness		**1**
DRUJ pin migration		**1**
Ulnar pin migration requiring reoperation		**1**
Trigger finger requiring release		**1**

128. Clinical Outcomes of 2.7 mm Nonlocking Plates for Open Reduction and Internal Fixation of Clavicle Fractures

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*Yvonne M. Murtha, M.D.	Wichita, KS
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INTRODUCTION: As pre-contoured locking plate fixation becomes more popular and healthcare costs rise, use of more economical clavicle implants that are lower profile should not be overlooked. The purpose of this study is to evaluate the clinical results of patients treated for clavicle fractures using a 2.7 mm plate fixation.

METHODS: An IRB-approved retrospective review was done of all patients that underwent clavicle fracture ORIF from January 2006 to July 2010 at a level 1 trauma center. Sixty-five patients with 65 clavicular fractures treated with the 2.7 mm plates were identified. Medical records were reviewed to determine demographic data, medical comorbidities, rate of infection, nonunion, nerve injury, painful hardware, secondary surgeries including hardware removal, and functional outcomes.

RESULTS: Sixty-one out of 65 patients were followed to union, yielding a 94% follow-up rate. 2.7 mm DC plates were used in 41 patients, 2.7 mm LCDC plates were used in 17 patients, and 2.7 mm reconstruction plates were used in 3 patients. A ten-hole plate was used most frequently (27.6%). Both superior (n=26) and anteroinferior (n=35) plating were performed. Fifty-eight of 61 (95%) fractures healed uneventfully. There were zero nonunions. Complications that occurred include 1 (1.6%) hardware failure (LCDCP), and 1 (1.6%) deep infection. Five (8.2%) patients reported painful hardware, but only two (3.3%) patients had hardware removal (both anteroinferior plates). Clinically, nine (14.8%) patients had greater than 10° shoulder flexion limitation, and ten (16.4%) had greater than a 10° limitation of shoulder abduction. A majority of patients showed 5/5 strength for all rotator cuff muscles. All patients reported return to regular daily activities they had enjoyed prior to injuries.

DISCUSSION: In the largest series known, 2.7 mm plate constructs performed exceptionally well for ORIF of displaced clavicle fractures with very limited complications including a 1.6% failure rate. Previously reported smaller series have reported failure rates of 12%.

129. The Accuracy of Pedicle Screw Insertion Using Intraoperative Three-Dimensional Image Guidance

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*Charles Gerald T. Ledonio, M.D.	Minneapolis, MN
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OBJECTIVE: To determine the accuracy and safety of intraoperatively acquired three dimensional (3D) image-guided insertion of pedicle screws using screw revision rate, reoperation rate, and incidence of neurovascular injuries as outcome measures.

INTRODUCTION: Image-guided navigation has led to increased accuracy rates for pedicle screw placement. This is the largest study demonstrating the accuracy and safety of pedicle screw insertion using intraoperative 3D image-guided navigation. Screw revision rates, reoperation rates, and incidence of neurovascular injuries are used as outcome measures.

METHODS: Between April 2007 and September 2010, 227 patients underwent pedicle screw instrumentation using intraoperatively acquired 3D image-guidance. Another intraoperative 3D scan was performed after insertion of the screws to assess pedicle screw position and to permit intraoperative revision as necessary. The accuracy of pedicle screw placement was then determined based on the screw revision rates, reoperation rates for a malpositioned screw, and occurrence of neurovascular complications.

RESULTS: A total of 2,495 screws were placed. Sixty-three screws were revised intraoperatively for a 2.5% revision rate. There were no patients that required a return to the operating room for a malpositioned screw. There were no major neurologic, vascular, or visceral injuries.

CONCLUSIONS: The overall accuracy of open intraoperative CT image-guided pedicle screw insertion was 97.5%. More importantly, there was a 0% reoperation rate and no major neurologic or vascular injuries using this technique.

130. The Effects of Preoperative Narcotic Use on Pain Management After Total Knee Arthroplasty

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INTRODUCTION: Increasing numbers of patients are being treated with narcotics for chronic pain and arthritis. This creates challenges in postoperative pain management for the orthopedic surgeon providing surgical interventions. This is a retrospective study to assess the effects of preoperative narcotic use in patients undergoing unilateral total knee replacement.

METHODS: An IRB approved total joint database was used to identify 23 study patients that used narcotics for pain management preoperatively, and 46 controls patients selected over a six-month time frame. Patients were matched for age, sex, and diagnosis, and all underwent an initial unilateral primary total knee arthroplasty. Hospital records were reviewed to determine the patient self reported pain levels, dosage, and types of narcotics (recorded in relative units) used throughout the hospitalization, as well as any complications.

RESULTS: The study group had slightly worse preoperative pain scores (13.9 vs. 16), range of motion (4.5-103 vs. 5.4-117), Knee Society knee (42.3 vs. 46.2), and function (37 vs. 50) scores. The study group had a higher average pain level (6/10 vs. 4.7/10, $p < .05$) while in the hospital, and had higher narcotic consumption (311 units vs. 132.7 units, $p < .001$). Pain and knee scores were significantly improved at six weeks in both groups (pain 38.2 vs. 42.9, knee score 81.5 vs. 82.4, $p < .001$). By six months, pain, knee, and function scores had improved significantly in both groups (pain 43.3 vs. 45.6, knee score 84 vs. 87, function 67 vs. 78.8 $p < .001$). Minor complications were observed in 4 (17%) study patients and 9 (20%) control patients.

CONCLUSIONS: Patients on preoperative narcotic pain management therapy can get good results from total knee arthroplasty, but will have higher postoperative narcotic usage and worse pain scores through the hospitalization and up to six weeks postoperatively. Opportunities exist for better pain management strategies for narcotic sensitized individuals.

131. Pulmonary Findings in Asymptomatic Postoperative Total Joint Arthroplasty Patients

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David C. Markel, M.D. Southfield, MI

INTRODUCTION: We have noticed an increase in the diagnosis of pulmonary embolus on postoperative day (POD) #1 and #2. We know that fat emboli are released into the venous circulation during total joint arthroplasty (TJA). We examined asymptomatic patients with multi-detector CT scan to establish the baseline pulmonary findings after TJA.

METHODS: We prospectively scanned 20 patients. Vital signs (temperature < 38°C, heart rate < 100 beats per minute, RR < 20 breaths per minute, 02 saturation > 92% on room air) and serum creatinine (< 1.1 mg/dL) were normal and closely monitored. All patients were mobilized early, wore thromboembolic stockings and foot pumps, and received 5 mg warfarin on the night of the procedure. On POD #1, patients underwent multi-detector CT angiogram of the chest. A single radiologist, blinded to the study, evaluated the images.

RESULTS: Twenty patients met inclusion criteria. There were 15 TKAs and 5 THAs, 8 males and 12 females. The average age was 62 years. Surgeries were done under spinal in 17 patients and general in 3. Average tourniquet time for TKA was 53 minutes. All of the CT scans were negative for PE. There were no signs of micro emboli or fat emboli on any scan. No patient went on to develop a PE at one year postoperatively.

DISCUSSION/CONCLUSION: Despite the fact that emboli are created during TJA, if emboli are seen on a CT scan postoperatively, they should be assumed to be real events with clinical sequelae. If symptoms develop postoperatively, they should not be assumed to be related to “fat embolism”. In this prospective baseline study, all patients had entirely negative exams without signs of intraoperative emboli.

MAOA BREAKOUT SESSION #11
TOTAL KNEE
April 21, 2012

132. Pain and Dissatisfaction Following TKA Performed for Early Stage Osteoarthritis

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(Presented by Muyibat A. Adelani, M.D., St. Louis, MO)

INTRODUCTION: A study was undertaken to assess the association between objective rating of preoperative degree of osteoarthritis and occurrence of pain and dissatisfaction following TKA.

METHODS: All patients referred to a university total joint clinic for a painful TKA of unknown etiology during a one-year period were examined. Cases included for study had pain rated moderate or worse and knees that were otherwise clinically and radiographically normal with no evidence of loosening, instability, malalignment, infection, or extensor mechanism dysfunction. Preoperative radiographs were successfully obtained in 41 of 52 knees (79%). The degree of OA was graded on the Kellgren and Lawrence classification in which grades 1 and 2 are early stage OA with possible joint space narrowing. Three other matched cohorts of TKAs from the same center with radiographically normal TKAs had their preoperative radiographs graded - Group 1 (n=108) a consecutive series of primary TKAs performed for OA during the same year, Group 2 (n=80) were asymptomatic at 1-4 years, while Group 3 (n=80) had some degree of pain at 1-4 years.

RESULTS: The study group had a highly statistically significant higher incidence of early grade OA preoperatively compared to any of the control groups (20/41, 49% vs. 5.5%, 6.25%, and 10% respectively, $p < .0001$). Among TKAs performed at the study center, patients who were asymptomatic were more likely to have had Grade 4 OA preoperatively than those who had some degree of pain at follow-up (69% vs. 53%, $p = .05$).

DISCUSSION AND CONCLUSION: An extraordinarily high percentage of patients referred for unexplained pain following TKA had very early stage OA preoperatively. Patients undergoing TKA for less than Grade 4 OA should be informed that they are at higher risk for persistent pain and dissatisfaction.

133. Is Minimal Preoperative Degenerative Arthritis a Predictor of Poorer Outcomes?

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INTRODUCTION: Though most surgeons presume that patients with more severe degenerative osteoarthritis (OA) are better candidates for TKA, there is little data comparing outcomes based on the extent of radiographic OA. We sought to test the hypothesis that patients with minimal radiographic OA would have inferior outcomes to a matched cohort with severe OA.

METHODS: Our total joint registry identified 29 patients (32 knees) with minimal degenerative changes (Kellgren and Lawrence Grades 0-2) who had a TKA between 2000 and 2004. We then identified a matched cohort with severe OA (age, sex, surgeon, BMI, and side of surgery). The mean follow-up was 5 years (2-10 years).

RESULTS: Preoperative knee scores were 63 and 59 in the minimal OA group and severe OA groups. Postoperative knee scores were 89 and 93 respectively. Preoperative function scores were 57 and 56 in the minimal OA group and severe groups. Postoperative function scores increased to 79 and 72, respectively. Twenty-seven out of 32 patients (84%) in the minimal OA group had mild or no pain at the time of last follow-up, while 5 (16%) had moderate or severe pain. Twenty-six out of 32 patients (81%) in the severe OA group had mild or no pain at the time of last follow-up, while 6 (19%) had moderate or severe pain. Six of 32 knees in the minimal OA group (18.9%) experienced a complication. These included three manipulations under anesthesia, one deep infection, one superficial infection, and one saphenous nerve neuroma. Only 1 of 32 knees (3.1%) in the matched cohort experienced a complication.

CONCLUSION: Patients with minimal preoperative radiographic arthritis constituted less than 1% of the patients undergoing TKA at our institution and had a higher risk of complications, but similar pain relief, function, and satisfaction compared to a matched group with severe arthritis.

134. Return to Sports and Sports-Related Activity Following Unicompartmental Knee Arthroplasty – Preliminary Results

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INTRODUCTION: Few studies have analyzed the rate of return to sports following unicompartmental knee arthroplasty (UKA). None of these studies have been done in the United States, and none of these studies have compared the results of returning to sports after UKA versus similar patients who underwent total knee arthroplasty (TKA) for isolated medial compartment disease.

METHODS: Thirty-one patients (35 knees) ages 45-65 years who underwent UKA and 11 patients (18 knees) who underwent TKA for isolated medial compartment OA between January 1, 2006, and December 31, 2009, were contacted via phone and completed a return to sports questionnaire, an UCLA activity score, and a Tegner-Lysholm knee scale. This group of TKA patients was deemed to have been eligible for a UKA and presumed to have undergone a TKA because the procedure was not offered/available due to the choice of surgeon.

RESULTS: The mean age of patients in the UKA group was 58.5 years (range 45.7-65.9) and in the TKA group was 61.1 years (range 52.2-65.2). The mean follow-up time was 3.8 years and 3.7 years, respectively. Preoperatively, 23/31 (74.2%) patients who underwent UKA and 10/11 (90.9%) patients who underwent TKA participated in sports or sports-related activities. Postoperatively, 22/23 (95.7%) patients who underwent UKA and 8/10 (80%) patients who underwent TKA were able to return to sports and sports-related activities.

DISCUSSION: Patients who underwent UKA for isolated unicompartmental OA at our institution were able to return to sports at a very high rate, consistent with other published international studies. Similar patients who underwent TKA were also able to return to sports at a high rate that appears to be less than their UKA counterparts, but greater than other published data for TKA patients. We expect to recruit additional TKA patients from a second surgeon who does not perform UKA in order to allow for matching our cohorts and appropriate statistical approximation.

135. Total Knee Arthroplasty in the Morbidly Obese Patient: Early Clinical Outcomes Using a Rapid Recovery Program

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METHODS: A prospective review of 83 consecutive patients with a BMI greater than 40 kg/m undergoing primary total knee arthroplasty was performed between September 2008 and February 2010. All surgical exposures were performed without eversion of the patella. All patients underwent a preoperative educational and physical therapy program for two weeks, as well as a monitored postoperative physical therapy program, focusing on the prevention of inflammation and soft tissue swelling, as well as early restoration of range of motion. A pre-emptive, multimodal pain management protocol was also utilized in all patients.

Clinical outcomes were assessed including surgical time, anesthesia type, length of stay, transfusion rate, ICU admissions, wound healing complications, preoperative range of motion, postoperative range of motion, DVT, and PE. Knee Society Scores (KSS) were assessed pre-operatively and at three months, six months, and one year postoperatively. Functional Knee Society Scores were also assessed at these same intervals. Anatomic and mechanical axis evaluation was also performed on all patients with long standing radiographs.

RESULTS: Eighty-three consecutive patients were reviewed with a BMI greater than 40 kg/mm. There were 64 females and 19 males with an average BMI of 44.10 kg/mm, (range 40.03-51.51kg/mm). Average surgical time was 45.2 minutes, with spinal anesthesia being utilized in 60 patients and general anesthesia in 23 patients. Average length of stay was 2.9 days with 79 patients discharged to their home, and 4 patients discharged to a rehab facility. No patient required ICU admission, and no patients developed a DVT or PE. One patient required a transfusion for a hemoglobin of 7.8 gm/dl. A mid-vastus surgical approach was used in 27 patients, and a medial arthrotomy was used in 56 patients. Patellar eversion was avoided in all cases.

Average preoperative KSS score was 48, with a postoperative KSS score of 81 at an average follow-up of six months postoperative. Average preoperative Functional KSS score was 37, with an average postoperative Functional KSS score of 70. Average range of motion at six months postoperative was 0-112°. All patients had alignment restored to a zero mechanical axis with an average femoral-tibial axis of 5° (range 4°-8°).

136. How has Age and Comorbidity Burden in Joint Replacement Patients Changed?

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INTRODUCTION: The specific aim of this study was to describe changes in age and comorbidity burden on joint replacement patients in the United States.

METHODS: Trends for over 1.3 million joint replacement procedures, reported in the National Inpatient Sample were examined for years 2000-2002, 2003-2005, and 2006-2008. Comorbidities were defined as two or more of the 29 conditions defined using ICD-9-CM diagnosis codes by Elixhauser. Logistic regression was used to estimate patient, surgeon, and hospital factors associated with care of patients with comorbidity.

RESULTS: Hypertension, deficiency anemia, and obesity were the most common conditions (56%, 12%, and 11%) with the fraction of patients having two or more conditions increasing from 22% in 2000-2002 to 36% in 2006-2008. The fraction of patients younger than age 65 increased and was higher for hip (43 vs. knee 39% in 2000-2002; 50 vs. 46% in 2006-2008), but the fraction with comorbidity in these younger patients was lower in hip (23 vs. 30% for knee). The fraction with comorbidity was higher with Medicaid (36 vs. 31% Medicare, 25% private) and low volume surgeons (30 vs. 27% for high volume). The odds ratio for comorbidity increased 90% for 2006-2008 compared to 2000-2002 (Odds Ratio 1.90 95% CI 1.87-1.91, $P<0.001$). Medicaid patients were 60% more likely than Medicare to have comorbidity (1.60, 1.58-1.63) and private 22% less likely (0.78, 0.77-0.79).

CONCLUSION: Type of insurance and surgeon volume were the biggest drivers for patient comorbidities. There were many complex interactions for this analysis because we were looking at changes in both age and comorbidity burden. Fractures were excluded from this analysis. When included, the number of hip cases almost doubles. The fraction with comorbidity increases with age for hip, but not for knee for age ≥ 50. The majority of Medicare patients are older than age 65 and most Medicaid and Private are younger than age 65. Medicaid and Medicare have a higher fraction of patients with comorbidity compared to private, and the fraction with comorbidity for these cohorts is highest in the age 51-65 group.

137. Manipulation After Total Knee Arthroplasty: Prognosis and Range of Motion

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INTRODUCTION: Knee stiffness following total knee arthroplasty (TKA) may compromise the outcome of the procedure. Manipulation under anesthesia (MUA) usually results in improvement of range of motion (ROM), but the outcome depends on various factors. The purpose of this study was to evaluate the effectiveness of MUA following TKA and identify prognostic factors predictive of post manipulation ROM.

METHODS: A retrospective review of prospectively collected epidemiological, medical, and surgical data over an eight-year period was conducted on 119 knees in 96 patients who underwent MUA after TKA. These patients were compared to 137 matched control cases not requiring MUA after TKA.

RESULTS: The mean rate of MUA was 3.7%. The mean preoperative ROM ($p = 0.004$) and final ROM ($p < 0.001$) was significantly lower in the MUA group versus the non-MUA group. The average increase in ROM following MUA was 34° ($p = 0.001$). Caucasians had a higher final ROM following MUA as compared to non-Caucasians ($p = 0.003$). In both groups, the number of comorbidities per patient had a summative effect with significantly lower final ROM with each additional comorbidity (all $p < 0.05$). In the MUA group, final ROM was significantly higher in posterior stabilized knees versus cruciate retaining knees ($p = 0.02$). Within the MUA group, general anesthesia alone during the index case was associated with significantly lower final ROM ($p = 0.04$). The interval between TKA and MUA inversely correlated with final ROM ($r = -0.20$, $p = 0.04$) with a significant decrease in final ROM at intervals greater than 75 days ($p = 0.001$).

CONCLUSIONS: Stiffness following TKA can be improved with MUA. Patients with low preoperative ROM, non-Caucasian race, and comorbidities are associated with poorer final ROM. Spinal anesthesia or general anesthesia in conjunction with regional anesthesia or peripheral nerve block is associated with improved ROM. MUA within 75 days of TKA is associated with better final ROM.

138. Mechanical Axis Alignment Did Not Predict Dynamic Knee Joint Loading After Modern TKA

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INTRODUCTION: One long-held tenet in TKA is to obtain neutral mechanical-axis alignment in an effort to produce balanced knee joint loading and maximize implant longevity. The precise relationship between static mechanical-axis alignment and the loads experienced at the knee during dynamic activities of daily living has not been examined closely after TKA. We sought to test the hypothesis that a neutral postoperative mechanical axis would routinely result in balanced knee joint loading during level walking and stair climbing activities.

METHODS: As part of a randomized clinical trial to assess outcomes after TKA, 40 patients were enrolled in a protocol that included comprehensive gait analysis, strength testing, and patient derived outcomes measures done preoperatively, at two months postoperatively, and at two years postoperatively. The patient group was representative of a contemporary TKA group with a mean age of 66 years, a mean BMI of 31, and a slight predominance of females over males. Gait kinematic parameters were acquired with a state-of-the-art computerized video motion analysis system during level walking trials. Mechanical axis alignment was calculated from digital full-leg hip-knee-ankle radiographs performed per protocol and a validated, computational model was utilized to calculate medial tibial plateau loading experienced during static standing and during the stance phase of the gait cycle. The relationship between mechanical axis alignment and medial plateau loading was assessed preoperatively and postoperatively at two months and at two years.

RESULTS: Preoperatively, the mean static medial load was 54% ± 3% (reflecting the predominance of varus degenerative arthritis) and two months and two years postoperatively, the mean static medial loads were, 50% ± 1% and 50% ± 2% respectively. However, both pre-operatively and at two months and two years postoperatively, the dynamic medial load percentage did not correlate closely with mechanical-axis alignment. While the overall mean values for the group approached balanced 50/50 loading of the tibia, there were substantial individual differences. Preoperatively, the mean dynamic medial load was 61% ± 22% and two months and two years postoperatively, the mean dynamic medial loads were, 51% ± 11% and 44% ± 19%, respectively. The two-month data was not predictive of the two-year data. At two years postoperatively, 89% of patients achieved the surgical mechanical axis alignment goal (0° ± 3°), but only 56% of patients had a dynamic medial load distribution of 50 ± 10%. Additionally, at two years, 22% of subjects experienced pain, but these subjects achieved both the alignment and loading targets.

CONCLUSIONS: A neutral mechanical axis remains a useful goal in TKA, but for a substantial number of patients that does not result in balanced knee loading. This data may provide insight to why some well-aligned knees fail and some outliers prove durable.

139. Should Preoperative Deformity Determine Femoral Component Rotation in Total Knee Arthroplasty?

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INTRODUCTION: Most surgeons utilize one of three axis options in conventional total knee arthroplasty (TKA), the transepicondylar axis (TEA), Whiteside's line (WSL), or the posterior condylar axis (PCA) to set femoral component rotation. Many surgeons believe the TEA to be the gold standard for determining neutral rotation. WSL and PCA have been used as surrogates for determining axial rotation in conventional TKA. The goal of this study was to examine if coronal plane deformity had any effect on the relationship of conventional referencing options such as WSL and PCA to the TEA.

METHODS: Utilizing preoperative plans based on magnetic resonance imaging (MRI), we compared the preoperative posterior femoral condyle resections for three different axis options in 176 TKA. The difference in bone resection amount was used to determine the rotational differences between the axis options in all knees. Assuming that the TEA was the ideal rotational axis, we compared the TEA to both WSL and PCA. A 1-sample t-test and paired t-test were then used to determine if there was a significant rotational difference between the various axis options when accounting for degree and direction of preoperative deformity in the coronal plane.

RESULTS: In the overall population of 176 knees (42 valgus, 134 varus), neither WSL or PCA approximated the TEA accurately ($p=0.016$ and 0.001). In valgus deformity, WSL was found to approximate the TEA ($p=0.68$) better than the PCA ($p=0.21$). Minor varus deformity ($< 3°$) favored the use of PCA (0.53) while moderate varus deformity (3-6°) favored use of WSL ($p=0.76$). Severe varus ($>6°$) deformity favored use of PCA due to lower variability.

CONCLUSION: MRI based preoperative planning indicates that the degree and direction of preoperative coronal plane deformity should help guide the choice of WSL or PCA to approximate the TEA in TKA.

140. What We Can and What We Can't Learn from Minimum 20-Year Follow-Up Studies of Total Knee Replacement

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INTRODUCTION: There are very few studies of total knee replacement where cohorts of patients have been followed for a minimum of 20 years. The purpose of this study was to examine the minimum 20-year follow-up of two prospectively followed cohorts of total knee replacement patients to determine what pertinent findings would be helpful for performing and designing total knee replacements today as well as to provide insight into the future study of total knee replacement.

METHODS: Two consecutive series of total knee replacement cohorts were performed sequentially in a single orthopedic practice and were prospectively followed for a minimum of 20 years both clinically and with serial radiographs. One cohort received a rotating platform knee design and the second a modular tibial tray design. In the first cohort, 119 knees were performed in 86 patients, average age 70 at the time of surgery. The second cohort consisted of 101 knees performed in 75 patients, average age 70. Survival curves of the patients themselves were performed for the various age groups.

RESULTS: In the first cohort, 20 patients with 26 of the 119 knees were still alive and in the second, 16 patients with 22 of 101 knees were still alive at 25-year follow-up. Revision rates for aseptic loosening were 0% and 5%, respectively and osteolysis rates were 5% and 9%, respectively. In both groups, the survivorship at 20 years for patients over 65 at surgery was 19% and for patients under 60 was 50%.

DISCUSSION AND CONCLUSION: At 20-year follow-up, these studies demonstrate the durability of total knee replacement, the small differences and results of elderly patient cohorts, and the need to follow large cohorts of younger patients in the future to have adequate numbers of patients surviving at 20 years to make pertinent observations.

141. A Comparison of Wound Closure with Absorbable and Metal Staples After Knee Arthroplasty

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INTRODUCTION: The use of an absorbable staple for wound closure has been shown to be very effective in closing hip incisions. This study evaluates this technology for closing knee incisions. This was a randomized controlled pilot study comparing incision closure with absorbable or metal staples after knee arthroplasty.

METHODS: Twenty patients undergoing bilateral patellofemoral (1), unicondylar (6,) or total knee arthroplasty (13) had one knee each randomized to be closed with either an absorbable or metal staple. There were 15 females and 5 males with an average age of 63.7 years, and average BMI of 33. Wound healing and patient satisfaction were assessed at discharge, two weeks, and six weeks, with records of drainage, erythema, perceived incisional pain, and cosmetic appearance. Wounds were closed with the knees in 45-60° of flexion.

RESULTS: An average of 17 absorbable staples were used for an average incision length of 15.5 cm in the study group, compared to 20.9 metal staples in incisions averaging 15.9 cm in the control group. Additional sutures were placed on the first or second postoperative day in six TKA knees in the study group and one TKA knee in the control group for persistent bleeding ($p<.01$). One study knee had persistent drainage at two weeks due to a protruding absorbable staple. None of the unicondylar knees had wound healing complications. All knees were well healed by six weeks with no infection or cellulitis. Incisional pain was felt to be equal in 9 and less in 8 of the study knees at discharge, equal in 9 and less in 10 of the study knees at two weeks, and equal in 10 and less in 6 of the study knees at six weeks. The resorbable stapler performed well in unicondylar knees, but allowed more drainage and bleeding in the total knee wounds. This may have been due to the length of the TKA incisions and subsequent stretching of the wounds with flexion, or the use of an inadequate number of staples for closure. Despite this, patient comfort was greater with the resorbable staples and wound healing was more cosmetically acceptable ($p<.01$).

CONCLUSIONS: Absorbable staples were less effective than metal staples for knee arthroplasty closure, and while acceptable for unicondylar incisions, should be used with caution in total knee incisions.

142. Periprosthetic Supracondylar Femur Fractures: Mechanical Relevance of Anterior Cortex Notching

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PURPOSE: The prevalence of supracondylar fractures after total knee arthroplasty (TKA) is approximately 1%. Procedure related factors including notching of the anterior cortex of the distal femur have been discussed controversially. The purpose of this study was to define risk factors for periprosthetic supracondylar femur fractures after TKA.

METHODS: Thirty-five patients had operative treatment of 35 supracondylar femur fractures after total knee replacement between 2002 and 2009 in two level 1 trauma centers.

RESULTS: Mean age was 75.7 years (range 59-95 years). Gender was 4 male and 31 female patients. The average BMI was 31.0 kg/m^2 (11.3-62.1 kg/m^2). Mean follow-up was 19 months (1-89). Mechanism of injury was low energy fall (30, 85.7%), high-energy fall (1), motor vehicle accident, and unknown (3). All patients were classified as 33A fractures. Eleven patients (31.4%) were diagnosed with notching of the anterior femoral cortex. The mean time from TKA implant to fracture was 67.3 months (2-180). The mean time to fracture for patients with anterior notching was 40.4 months (2-123) compared to 80.8 months (3-180) for patients without anterior notching. The mean distance from prosthesis to fracture measured on plain radiographs was 26 mm (0-109 mm). Distance from prosthesis to fracture was significantly shorter with notching (5.6 mm, 0-32 mm) than without notching (35.3 mm, 0-109 mm) ($p<0.001$). In addition, with notching, 81.8% (9/11) had a fracture ≤ 6 mm from the prosthesis compared to 33.3% (8/24) without notching.

CONCLUSION: Different general risk factors for femoral fractures proximal to a TKA have been documented. These fractures have been associated with rheumatoid arthritis, chronic steroid therapy, and other conditions that result in osteopenia of the distal part of the femur. Procedure related factors including notching of the anterior cortex of the distal femur have been discussed controversially, but may influence survival of total knee arthroplasty. Our findings strongly suggest notching of the anterior femoral cortex during TKA influences fracture pattern and risk of early fracture, decreases surgical treatment options, and increases morbidity.

143. A Comparison of the Accuracy of Customized Instrumentation in TKA Between Arthroplasty and General Orthopedic Surgeons

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INTRODUCTION: Computer-assisted surgery (CAS) was developed to improve limb and implant alignment in TKA. It has not been found helpful to the general orthopedic surgeon. Customized instrumentation (CI) utilizes preoperative MRI reconstructions and may offer the general orthopedic surgeon a more accurate and reproducible TKA. The purpose of this study was to evaluate the accuracy with which joint arthroplasty surgeons at a large academic institution and a general orthopedic surgeon in a community hospital could perform TKA using CI.

METHODS: 111 CI TKA were performed by two joint arthroplasty-trained surgeons at a large academic institution, and 98 CI TKA were performed by a general orthopedic surgeon in a community hospital. CI-predicted femoral and tibial component size from the CI template was compared to the actual component selection. CI-predicted resection levels for the femur and tibia were recorded and compared to the actual resections using manual calipers. The frequency and magnitude of additional bone resections were recorded. Postoperative radiographic alignment was evaluated.

RESULTS: The CI system accurately predicted femoral component size in 89% of cases for the arthroplasty-trained and 93% for the general orthopedic surgeon. Results were similar in regards to the discrepancy between CI predicted and actual femoral and tibial bone cuts ($p > 0.05$). The frequency of additional bone resections beyond the CI predicted resections was similar. Postoperative radiographic alignment was similar between the two groups.

DISCUSSION: Customized instrumentation is capable of accurate TKA for both the arthroplasty-trained and general orthopedist. The adaptability of the system to familiar instruments, ease of placement of the customized cutting guides, ability to perform the anatomic registration preoperatively in three-dimensions, and reduced instrumentation requirements are notable benefits of CI. Customized instrumentation is capable of accurate TKA and may offer an attractive alternative to CAS for the performance of a more accurate TKA, especially for the general orthopedic surgeon.

144. A Comparison of Computer-Based Anatomic Registration Techniques in TKA: CAS and Customized Instrumentation

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INTRODUCTION: Computer-assisted surgery (CAS) is a tool developed to allow accurate limb and implant alignment in TKA. The accuracy of this ligament balancing technology depends upon an accurate determination of femoral component size. This size is established with intraoperative surface registration techniques. Customized instrumentation (CI) is a measured resection technique in which component size is established on preoperative 3D MRI reconstructions. The purpose of this study is to determine how these two computer-based technologies compare with regard to the accuracy with which femoral component size is established in TKA.

METHODS: Sixty-seven TKA were performed using CI and 30 TKA were performed using CAS by a single surgeon. CI-predicted and CAS-predicted femoral component size were compared to actual component selection. The process by which CI and CAS perform an anatomic registration was evaluated.

RESULTS: The CI and CAS systems accurately predicted surgeon-selected femoral component size in 89% and 43% of cases, respectively ($p<0.001$). The discrepancy between predicted and actual femoral component size with CI and CAS was 0.1 and 0.8 sizes, respectively ($p<0.001$) with the maximum discrepancy greater in CAS.

DISCUSSION: The CI system was both more accurate and more precise than the CAS navigation system in predicting femoral component size in TKA. CI bases implant sizing solely on reproducing an anatomical fit and a measured resection technique, whereas CAS attempts to balance an anatomic fit with optimal soft tissue balancing. In this study, the surgeon's final component selection was more likely to be in accordance with the CI rather than the CAS sizing algorithm. This study suggests that intraoperative surface registration may not be as accurate as preoperative 3D MRI reconstructions for establishing optimal femoral component sizing.

MAOA BREAKOUT SESSION #12
SHOULDER/TRAUMA
April 21, 2012

145. Is Biphosphonate Use Associated with Atypical Humeral Diaphyseal Fractures?

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INTRODUCTION: A number of recent case series and retrospective reviews have identified a subgroup of atypical fractures of the femoral shaft associated with bisphosphonate use. These case series have suggested that long-term bisphosphonate use may ultimately alter bone strength, most likely due to suppression of bone turnover. The purpose of this study was to determine whether there was an association between bisphosphonate use and atypical humeral diaphyseal fractures.

METHODS: From 2003-2010, a retrospective review of patients with humeral fractures was completed.

RESULTS: Seventy-one humeral diaphyseal fractures with low energy mechanism of injury were identified in 50 (70%) females and 21 (30%) males with an average of 74 (50-96). Thirteen of 71 (18.3%) had current or prior bisphosphonate usage. A statistically significant difference (p=0.001) occurred in the incidence of atypical fractures between prior bisphosphonate use 8 of 13 (61.5%) as compared to 9 of the 54 (16.7%) without bisphosphonates. The “atypical” diaphyseal humeral patterns were: 1 transverse or short oblique with cortical thickening (type I), 13 lateral bending wedge (type II), and 3 severely comminuted (type III). Patients with “atypical” fracture patterns had bisphosphonate usage for an average of 5.6 years (0.4-12 years) compared to 2.4 years (0.4-4.8 years) of bisphosphonate usage for those without these fracture patterns. Additionally, worsening atypical fracture pattern type corresponded to duration of bisphosphonate usage.

CONCLUSION: Multiple case series have demonstrated that bisphosphonate usage is associated with atypical subtrochanteric femoral fractures. This is the first case series report to associate atypical diaphyseal humeral fractures with prolonged bisphosphonate use. Additionally, we recommend a classification scheme. Further analysis and prospective studies to more fully delineate the association between bisphosphonate usage and atypical fractures in the humerus and other parts of the skeleton are recommended.

146. Alendronate Inhibits the Effects of Interleukin-1 Beta on Rat and Human Type II Chondrocytes In Vitro

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In osteoarthritis, articular chondrocytes produce the pro-inflammatory cytokine interleukin-1 beta (IL-1β), which contributes to cartilage matrix destruction. Statins have anti-inflammatory properties and have a similar mechanism of action as alendronate. To evaluate the potential chondro-protective effects of alendronate, an in vitro model was developed to examine the effects of IL-1β on cartilage matrix production. Articular chondrocytes were dissected from knees of eight Sprague-Dawley rats, and knees of four human patients undergoing knee arthroplasty. Articular chondrocytes were isolated, sustained in alginate beads, and treated with IL-1β and/or alendronate. RNA was isolated for measurement of collagen type I and II, aggrecan, and matrix-metalloproteinase (MMP-13) gene expression using RT-PCR.

Type II collagen expression was higher than type I collagen in control treatments of rat chondrocytes ($p<0.0001$). Rat chondrocytes treated with IL-1β exhibited decreased gene expression of collagen type I (84%) and II (95%), aggrecan (75%), and MMP-13 (40%) when compared to untreated controls. Alendronate-treated rat chondrocytes had increases in gene expression of collagen type I (40%) and type II (59%), and partially restored decreases seen with IL-1β treatments. Preliminary results from human chondrocytes demonstrated higher collagen type II expression than collagen type I in control treatments ($p=0.007$); with IL-1β treatment, all genes exhibited decreased gene expression except MMP-13 (increased). Alendronate treatments increased gene expression of collagen type I (45%) and II (38%), aggrecan (30%), and ablated the effects of IL-1β.

IL-1β induces decreased expression of genes associated with cartilage matrix production in rat and human articular chondrocytes in vitro. Alendronate could be used to reverse these detrimental changes. This model will allow us to further evaluate different therapeutic regimens.

147. Functional Outcomes After Operative Management of Extra-Articular Scapula Neck and Body Fractures

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BACKGROUND: Some case series have suggested that a certain subset of patients with scapula fractures benefit from operative management. However, there have been no large, prospective case series critically examining the clinical and patient based functional outcomes after operative treatment. The purpose of this study is to assess the surgical and functional results after treatment of extra-articular scapula body/neck fractures.

METHODS: Seventy-two patients with extra-articular scapula fractures were treated surgically between 2002 and 2009. Fractures were classified according to the revised OTA classification. Indications for operative treatment included ≥ 20 mm “medialization” (lateral border offset), ≥ 45° of angulation, ≥ 15 mm “medialization” and ≥ 30° angulation, double disruptions of the superior shoulder suspensory complex displaced ≥ 10 mm, glenopolar angle ≤ 22° and open fractures. Clinical range-of-motion, strength and functional outcomes including DASH and SF-36 were obtained on 60 patients (83%).

RESULTS: At a mean follow-up of 25 months (range = 6-70), there was 100% union rate. Mean DASH score at follow-up was 13.7 (range = 0-58). For all parameters, mean SF-36 scores were comparable to those of the normal population. Range-of-motion in degrees for the operated/uninjured shoulder follows: forward flexion (154/158), abduction (103/105), and external rotation (65/70). Strength measured in pounds of force follows: external rotation (18/22), forward flexion (19/23), and abduction (14/16). Complications included removal of scapula hardware in five patients, manipulation under anesthesia in three patients, and exchange of intra-articular screws in two patients.

CONCLUSION: Our data suggest surgery for extra-articular fractures of the scapula is associated with good functional results and a low complication rate.

148. Does Pain Correlate with Patient Based Functional Outcome Scores After Proximal Humeral Fractures?

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PURPOSE: Proximal humeral fractures represent 4–5% of all fractures and occur in a bimodal frequency with younger high energy and older low energy mechanisms. Healing and functional results are complicated by osteoporosis, comminution, short-segment fracture length, and displacement. Limited validated musculoskeletal specific functional outcomes are reported in published literature. The purpose of this study was to evaluate the correlation of a validated visual analog scale (VAS) for pain with the SMFA indices in patients treated operatively for unstable proximal humeral fractures**.**

METHODS: A cohort of 140 patients treated operatively. SMFA and VAS pain scores (10 points) were prospectively collected at 6, 12, and 24 months. SMFA indices were correlated with the VAS for pain correlation matrix.

RESULTS: Gender was 112 (80%) females and 28 (20%) males with an age of 64 (18-94). The mean SMFA index scores were: daily activity 27.2, emotional 29.0, arm/hand 16.0, mobility 23.6, dysfunction 24.0, and bother 23.6. The pain VAS was 3.3 ± 2.9. Pain VAS had a significant correlation with all SMFA indices ($p<0.001$). Pain VAS was not affected by gender or age ($p=0.103$ and $p=0.509$, respectively). Females had significantly worse SMFA indices ($p>0.05$). Those ≥ 65 years had significantly worse daily activity, arm/hand, mobility, and dysfunction ($p<0.001$).

CONCLUSIONS: These findings suggest that pain is an important factor in the explanation of the patient-based SMFA for patients with operatively treated unstable proximal humeral fractures. Pain should be evaluated over time using a validated scale. Pain assessment is an efficient method to correlate functional status. Pain management is essential to attain optimal functional outcomes. Further study is needed with various traumatic fractures and large sample sizes to determine additional factors that may influence pain.

149. The Effect of Humeral Head Defect Size on Instability of the Shoulder

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BACKGROUND: The presence of a Hill-Sachs lesion can be a major contributor to failure of surgical intervention following anterior shoulder dislocation. The relationship between lesion size and location, measured on preoperative MRI, and risk of recurrent instability after surgery has not previously been defined.

HYPOTHESIS: We hypothesized that the size of Hill-Sachs lesions on preoperative MRI would be greater and the lesions located more anteriorly in the axial plane among patients who failed soft tissue stabilization when compared to patients who did not. We also hypothesized that a glenoid lesion would allow failure with smaller Hill-Sachs lesions.

METHODS: Nested case-control analysis of 114 patients was performed to evaluate incidence of failure after soft tissue stabilization. Successful follow-up of at least 24 months was made with 91 patients (80%). Patients with recurrent instability after surgery were compared to randomly selected age and sex matched controls in a 1:1 ratio. Preoperative sagittal and axial MRI series were analyzed for presence of Hill-Sachs lesions, and maximum edge-to-edge length and depth as well as location of the lesion related to the bicipital groove (axial) and humeral shaft (sagittal) were measured.

RESULTS: Of 91 patients included in analysis, 77 (84.6%) had identifiable Hill-Sachs lesions. Thirty-two patients (35.2%) suffered from failure of soft tissue stabilization. When comparing the age and sex matched failure and control groups, statistically significant differences in unadjusted data were found for axial edge-to-edge length ($p=0.01$), axial depth ($p=0.01$), and sagittal edge-to-edge length ($p=0.04$), with larger sized lesions found in the failure group.

DISCUSSION: In this retrospective case-control study, humeral head defect size was positively correlated with recurrent instability after soft-tissue stabilization. Larger Hill-Sachs lesions, as measured on preoperative MRI, were found in patients who failed surgical intervention when compared to patients who did not. These data may help determine preoperative clinical guidelines for the treatment of anterior shoulder dislocation.

150. Analysis of Neurovascular Safety Between Superior and Anterior Plating Techniques of Clavicle Fractures

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OBJECTIVES: Clavicle fractures are commonly plated as a method of fixation, with superior and anterior techniques described. Although advantages and disadvantages have been attributed to both, it is unclear if one approach provides a lower risk of neurovascular injury. The aim of this study was to compare the potential for neurovascular injury between these two plate locations in a cadaveric model.

METHODS: Seventeen adult fresh frozen cadavers underwent bilateral dissections exposing the clavicle and underlying neurovasculature. After taking baseline anatomical measurements, a superior and anterior clavicle plate was applied, removed, and measurements were taken from the nearest screw exit site to the underlying subclavian vein/artery and brachial plexus. The differences between superior and anterior measurements were compared based on proximity to the neurovasculature.

RESULTS: Distance to the vessels were unobtainable in six specimens (35%) plated with the anterior technique, due to the trajectory of the screws projecting cephalad to the vessels. In the remaining specimens, there was no significant difference in the distance to the subclavian vein/artery and brachial plexus in the superior plate position (9.2 ± 4.6, 12.2 ± 5.8, and 9.8 ± 5.2 mm, respectively) compared with the anterior plate position (8.3 ± 3.5, 12.2 ± 6.5, and 9.7 ± 5.3 mm, respectively). In addition, no significant difference in potential neurovascular injury with regard to body size or gender was found.

CONCLUSIONS: Overall, there was no significant difference found between superior and anterior plating in regards to potential neurovascular injury. However, there appears to be a subset of the population where anterior plating offers improved safety in relation to the subclavian vessels.

151. Patient Satisfaction with Cosmesis and Function Following ORIF of Mid-Shaft Clavicle Fractures

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INTRODUCTION: Displaced mid-shaft clavicle fractures may require surgical treatment. Despite the reported success of internal plate fixation, little data exists regarding overall patient satisfaction with regards to cosmesis and shoulder function.

METHODS: Twenty-eight consecutive patients underwent ORIF of an acute, mid-shaft clavicle fracture with LCDC-plate fixation and evaluated at minimum one-year follow-up. Subjects completed postoperative outcome measures (Short Form-12, American Shoulder and Elbow Surgeons Form, Western Ontario Rotator Cuff Index, and Western Ontario Osteoarthritis of the Shoulder Index). A new 100 point questionnaire was developed which evaluated many injury specific complaints, including shoulder posture, skin sensitivity, and cosmetic appearance of the surgical site. The patients were also asked about their overall level of satisfaction with the treatment method using a visual analog scale.

RESULTS: All fractures healed within three months of surgical treatment. The mean SF-12 score was 90.1, ASES 95.9, WOOS 130.8, and WORC 130.8, all of which are consistent with near normal subjective function. The average overall treatment satisfaction score was 92.8 of a maximum 100 points. Patient assessed outcome using the injury specific questionnaire demonstrated, on average, highest results with questions regarding function and strength, but lower scores dealing with cosmesis and local tissue irritation. The overall score using this new 100 point scale measured 25.2 of a possible 100 points. Three patients (10.7%) elected plate removal during the time of study.

CONCLUSION: ORIF of mid-shaft clavicle fractures results in predictable fracture healing. Patient satisfaction is generally high with regard to function, strength, and overall method of treatment. However, dissatisfaction with cosmesis and local tissue sensitivity remain a concern, as demonstrated by the low scores using an instrument to evaluate this issue. As a result, future comparative study with less invasive techniques, such as elastic nailing, is warranted.

SUMMARY: ORIF of mid-shaft clavicle fractures led to predictable fracture healing, but low outcome scores when evaluating cosmesis and local tissue irritation.

152. Progressive Displacement After Clavicle Fracture: Prospective Observational Study

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BACKGROUND: The amount of midshaft clavicle fracture displacement is linked to the patient's outcome. Furthermore, certain clavicle fractures have been shown to displace in the peri-injury time period. The purpose of this study is to (1) describe the incidence of progressive displacement greater than 1 cm in the peri-injury time frame, (2) compare different methods of measuring clavicle displacement through inter-observer reliability, and (3) determine whether supine versus upright position during radiography changes displacement.

METHODS: Prospective observational study in which 45 patients treated for a midshaft clavicle fracture had a specific radiographic protocol employed. Inclusion criteria included: (1) midshaft clavicle fracture within seven days of injury and (2) at least one follow-up with protocol x-rays. The protocol included three views: (1) standing 15° cepahalic tilted anteroposterior (AP), (2) supine 15° cepahalic tilted AP clavicle, and (3) supine 15° cephalic tilted AP panoramic shoulder girdle view. Vertical translation and medialization were independently measured by two trained examiners at all time points to detect changes resulting from patient positioning and time from injury.

RESULTS: Six patients (13%) had progressive medialization >1 cm, and four patients (9%) had progressive translation >1 cm. The interobserver reliability as determined by the concordance correlation coefficient was nearly perfect for the measurement of medialization (0.934) and translation (0.982). Repeated-measures ANOVA comparison of supine and upright films showed there was a significant difference in the amount of relative translation with the supine view showing 16% less relative translation than the upright ($p=0.04$), a trend toward significance in absolute translation ($p=0.06$), yet no statistically significant differences in medialization ($p=0.36$).

CONCLUSION: Our data suggest that close follow-up of nonoperatively treated clavicle fractures is warranted due to the risk of progressive displacement and that patient positioning does not significantly alter the amount of medialization, however, does affect translational displacement.

153. Reliability and Reproducibility of a New Method for Classifying Acromioclavicular Separations

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INTRODUCTION: Acromioclavicular (AC) separations are commonly classified using the Rockwood modified method, grading injury severity from 1 through 6. However, it is unknown whether this method is reproducible or reliable amongst clinicians. The purpose of the current study is to determine the accuracy of this classic evaluation method and to propose an alternative method of injury evaluation using specific radiographic measurements.

METHODS: We evaluated the radiographs of 21 subjects (21 injured shoulders, and 21 control shoulders, 42 total) in blinded fashion. A panel of three raters classified the injury severity as 1, 2, 3, or 5, and evaluated the standardized radiographs using a digital caliper to determine an AC injury severity ratio (coracoclavicular gap width/clavicular width). The AC injury ratio was correlated to the standard classification method, to determine average measurement ranges. The reliability and reproducibility of the two methods were then evaluated using standard statistical methods.

RESULTS: The standard modified Rockwell method showed moderate to strong reliability between raters, ICC (2,1) = .717 ($p<.001$) and showed strong reproducibility within each rater, ICC (1,1) = .928, .814, and .839, respectively ($p<.001$). Using digital measurements, the average injury severity ratio for a type I (or radiographic normal) was 0.70, for type II was 1.02, for type III was 1.41, and for type V was 2.09, with the average ratio increasing significantly between each type ($p<.01$). The novel method of injury classification using this ratio showed very strong reliability between raters, ICC (2,1) = .982 ($p<.001$) and very strong reproducibility within each rater, ICC (1,1) = .984, .957, and .980, respectively ($p<.001$). These results revealed an improvement from the accuracy of the standard modified Rockwood method.

CONCLUSION: Existing methods of AC injury severity classification have moderate accuracy amongst clinicians. A novel method is proposed that may be more accurate and reproducible, and may have utility not only in initial injury evaluation, but also in reporting of results of treatment.

SUMMARY: A new evaluation method of classifying AC injuries using digital measurements demonstrated a high level of accuracy.

154. Quantifying Glenoid Bone Loss in Anterior Shoulder Instability: Reliability and Accuracy of 2D and 3D CT Measurement Techniques

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BACKGROUND: Glenoid support is critical for stability of the glenohumeral joint. An accepted noninvasive method of quantifying glenoid bone loss does not exist. The purpose of this study was to evaluate the reliability and accuracy of standard two-dimensional (2D) and three-dimensional (3D) computed tomography (CT) measurements of glenoid bone deficiency.

MATERIALS AND METHODS: Glenoid defects were created in the anterior and anteroinferior locations of two anatomically shaped scapula bone substitutes. Each sample underwent 3D laser scanning to obtain true measurements followed by routine CT scanning. Six physicians measured separate linear indicators of bone loss and quantified bone loss using three defined methods on 2D and 3D CT. The intraclass correlation coefficient (ICC) was used to assess agreement and correlation coefficients (R^2) were used to compare radiographic and true measurements.

RESULTS: Using 2D CT, all measurements had fair to poor accuracy (R^2 =0.23-0.74), and agreement was good (ICC=0.81) only for measuring the length of the defect. Using 3D CT, only the Pico method had good accuracy (R^2=0.98). Agreement was good for all linear indicators of bone loss (range, 0.85-0.90), and for the ratio linear and Pico surface area methods used to quantify bone loss (range, 0.84-0.98). Defects in the anteroinferior location were consistently underestimated or undetectable using the width-to-length ratio as an indicator of bone loss and the glenoid index linear method to quantify bone loss.

CONCLUSIONS: The length of glenoid defects can be reliably and accurately measured on 3D CT. Bone defects in the anteroinferior location directly affect the true magnitude of bone loss measured using the glenoid index linear technique. The Pico and ratio techniques are most reliable; however, only the Pico method accurately quantifies glenoid bone loss in both the anterior and anteroinferior locations. Future work is required to implement reliable and accurate imaging techniques of glenoid bone loss into clinical practice.

155. A Biomechanical Comparison of Two Anatomical CC Ligament Reconstructions After Complete AC Dislocation

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INTRODUCTION: Various methods to reconstruct the CC ligaments anatomically have been described. This study was undertaken to compare the biomechanical properties of two reconstruction techniques of the CC ligaments using semitendinosus tendon allograft.

METHODS: Sixteen matched fresh frozen cadaveric shoulders were used for this study and one additional shoulder was used in the knot fixation group only. One shoulder in each matched pair was randomly assigned to anatomical CC ligament reconstruction utilizing either: anatomical 2-bundle CC ligament reconstruction technique described by Mazzocca et al. (n=8) or modification of the knot fixation technique described by Lee et al. (n=8). The intact CC ligaments were tested to failure in the superior direction at a rate of 2 mm/sec. After failure, reconstruction was performed utilizing a semitendinosus tendon allograft. Load-to-failure was then repeated for each construct. Ultimate failure load, stiffness, and mode of failure were recorded for each specimen and compared by paired t-test ($p<0.05$).

RESULTS: The peak load to failure for the intact specimens was 406.3 N and 422.5 N for the anatomical 2-bundle and modified knot fixation groups, respectively. The peak load to failure was 326.9 N and 347.5 N for each reconstruction technique, respectively. These differences were not significant between native and reconstruction. There was also no significant difference in peak load between the reconstruction techniques. The stiffness decreased significantly after reconstruction from 34.3 N/mm to 22.5 N/mm for the 2-bundle group ($p=0.035$) and from 35.5 N/mm to 21.9 N/mm for the modified knot fixation group ($p=0.043$). There was no significant difference in stiffness between the two reconstruction groups.

CONCLUSION: Although less stiff than the native ligament, either technique to reconstruct the CC ligament can be performed to yield a similar load to failure to the intact ligament. The tested techniques differed in their modes of failure.

156. Shoulder Arthroplasty as Treatment for Locked Posterior Dislocation of the Shoulder

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INTRODUCTION: Currently, there is little information available on the outcome of shoulder arthroplasty for the treatment of locked posterior dislocations of the shoulder. Therefore, the purpose of this study was to determine the results, risk factors for an unsatisfactory outcome, and rate of revision.

METHODS: Between 1978 and 2008, 32 patients with locked posterior shoulder dislocations were treated with a shoulder arthroplasty at our institution. Twenty-nine shoulders with complete preoperative evaluation, operative records, and a minimum two-year follow-up period or until the time of the revision surgery was included in the study. Average clinical follow-up for range of motion was 9.9 years while average radiographic follow-up was 6.6 years.

RESULTS: There was significant pain relief from 4.5 to 2.0 (1-5 scale) ($P<0.01$)) as well as improvement in external rotation from –20° to 30° ($P=0.0001$) and active abduction from 80° to 90° ($p>0.10$) with shoulder arthroplasty. On the basis of a modified Neer result rating system, there were 6 excellent, 13 satisfactory, and 10 unsatisfactory results. Four patients required revision surgery; 2 for recurrent instability, 1 for pain due to glenoid arthritis, and 1 for infection.

CONCLUSIONS: The data from this study indicates that shoulder arthroplasty for locked posterior dislocation provides pain relief. However, the improvement in active abduction was not significant with patients on average obtaining only half of normal motion. When recurrent instability did occur, it was in the early postoperative period and did not occur late.

MAOA BREAKOUT SESSION #13
PEDIATRICS/TUMOR
April 21, 2012

157. The Incidence of Femoral Head Osteonecrosis in Pediatric Femoral Neck Fractures: A 25-Year Study

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INTRODUCTION: Femoral neck fractures account for less than 1% of all pediatric fractures; however, femoral head osteonecrosis (ON) after this injury has been reported to range from 0-92%. The purpose of this investigation is to add our experience to the literature and identify factors that may increase the risk of ON in pediatric patients with femoral neck fractures.

METHODS: An IRB approved retrospective review identified 222 children with hip fractures treated at our institution from 1983 to 2008. Children were excluded if they had metabolic bone disease, subtrochanteric or pathologic fractures, slipped capital femoral epiphysis, had documented evidence of osteoporosis, or had less than one-year follow-up. This left 36 patients with 37 fractures in our study. Diagnosis of ON was based on radiographs, clinical data, or phone interviews. Statistics were used to analyze factors that could increase the risk of ON such as age, gender, classification, displacement, year treated, time to reduction, reduction type and quality, and whether a decompression was performed.

RESULTS: Of the 37 cases included in the study, 8 (22%) developed ON. The rate of ON for Delbet type I fractures was 50% (2/4), type II 25% (3/12), type III 9% (1/11), and type IV 20% (2/10). A Pearson chi-squared test revealed that age greater than 10 years was the only statistically significant independent predictor of ON ($p=0.037$). Further analysis did not identify any significant predictors of ON. There was no significant difference of ON rates between those undergoing early versus late reduction ($p=0.810$), nor was there a difference in ON rate if capsular decompression was performed or not.

CONCLUSION: Our study of 37 femoral neck fractures is a relatively large case series with low ON rates (22%). Our data show that ON is more likely to develop with increasing age with statistical significance ($p=0.037$). We were unable to demonstrate that early reduction decreased ON rates when compared to reductions that were delayed ($p=0.810$).

158. Long-Term Functional Outcomes Following Surgical Management of Pediatric Pelvic Aneurysmal Bone Cysts

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INTRODUCTION: Pelvic aneurysmal bone cysts (ABCs) affect the pediatric population far less frequently than appendicular ABCs. This study examines the long-term clinical, radiographic, and functional outcomes of children with pelvic ABCs treated at a single institution by a single treatment modality.

METHODS: Between 1988-2008, 142 children with histologically confirmed ABCs were treated at our institution. Seventeen (12%) tumors were located in the pelvis. Demographic data and presenting symptoms were recorded. Information about the location and extent of the lesion were collected by plain radiographs and axial imaging. Histologic diagnosis was confirmed in all cases. At most recent follow-up (mean 10.1 years, [range 1-19.8 years]), functional outcomes were assessed by the SF-36 Health Survey, the Musculoskeletal Tumor Society Score (MSTS), and the Toronto Extremity Salvage Score (TESS). An anteroposterior radiograph of the pelvis was assessed for acetabular index, lateral-center edge angle, and Tonnis osteoarthritis grade. Patients were stratified according to age less than 10 years, involvement of the tri-radiate cartilage by the lesion, intra-articular involvement, and use of phenol adjuvant therapy. Associations were evaluated using JMP statistical software to run 2 sample t-test assuming unequal variances, Wilcoxon Rank Sums test, and two-sided Fisher's exact test.

RESULTS: There were 9 boys and 8 girls with a mean age of 12 years (range, 4.1-17.5 years) at the time of diagnosis. Extended curettage with bone grafting was performed in all patients. At mean follow-up of 10.1 years, the average functional scores were 95.3% for TESS, 95.3% for the SF-36, and 92% for MSTS. Mean center-edge angle was 36.6° and mean acetabular index was 10.8°. Eleven patients were Tonnis Grade 0, three were Grade 1, and one was Grade 2. When assessing for age less than 10 years, tri-radiate involvement, intra-articular extension, and phenol adjuvant therapy, no significant difference was found in functional or radiographic outcomes. There were three recurrences. At final follow-up, 16/17 patients were free of disease.

CONCLUSIONS: Extended curettage and bone grafting of pelvic ABCs in the pediatric population can yield high functional scores at an average of ten years follow-up. Involvement of the tri-radiate cartilage, intra-articular extension of the lesion, and use of phenol did not affect clinical, radiographic, or functional outcomes.

159. Surgery and Actinomycin Improve Survival in Malignant Rhabdoid Tumor

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PURPOSE: Malignant rhabdoid tumor (MRT) is an uncommon tumor that rarely occurs outside of renal and central nervous system (CNS) sites. As such, there is no standard treatment. The data available in the literature were compiled to determine prognostic factors, including both demographic and treatment variables of malignant rhabdoid tumor, focusing on those tumors arising in extra-renal, extra-CNS (ER/EC MRT) sites.

PATIENTS AND METHODS: A systematic review meta-analysis was performed on all 167 cases of primary ER/EC MRT identified in the literature. Demographic and treatment data was abstracted for all cases and survival follow-up data for 139 patients.

RESULTS: No survival differences were observed between males and females, between those treated +/- radiation, or +/- chemotherapy. A Cox regression of overall survival revealed several independent prognostic factors. Surgical excision had a 75% ($p=0.0004$) improvement in survival. Actinomycin had a 74% ($p=.0059$) improvement in survival. Older age was associated with improved survival. The four year survival, by Kaplan-Meier estimates, comparing patients less than two years old versus older than two at diagnosis was 11% versus 35%, respectively ($p=0.0001$).

CONCLUSION: ER/EC MRT is a highly lethal, rare, soft-tissue tumor with a poor prognosis most commonly occurring in children. Surgical resection, treatment with actinomycin, and older age at diagnosis are all associated with improved survival.

160. Allograft Cortical Strut Reconstruction of Space Occupying Bone Lesions: Radiographic and Clinical Outcomes

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INTRODUCTION: Space occupying bone lesions present orthopedic surgeons with both clinical and surgical challenges. Various surgical, reconstructive procedures have proven successful in reconstructing small bone lesions. The lack of structural support necessary for large or peri-articular lesion reconstruction remains a clinical problem. This study analyzes the clinical outcomes of patients undergoing excision and reconstruction of large bone lesions with allograft cortical struts.

METHODS: This IRB-approved retrospective study includes sequential patients who underwent surgical curettage and cortical strut allograft reconstruction of space occupying bone lesions by the senior author (SDW). The primary outcome measures were lesion healing, graft incorporation, long-term pain, return to activity, and complications/recurrences.

RESULTS: There were 17 patients (9 female, 8 male) who met the inclusion criteria. At least partial lesion healing and allograft incorporation was identified in 88% (53% complete and 35% partial) of the lesions. Of the 15 patients who did not sustain a recurrence, 93% returned to full activities with little to mild pain. The majority of the lesions were aneurysmal bone cysts (35%) and non-ossifying fibromas (23%). The average lesion size was 107 cc, the average follow-up was 19.6 months, and no major complications were identified. One recurrence was a multiple recurring aneurysmal bone cyst and the other an osteosarcoma.

DISCUSSION: Allograft cortical strut reconstruction was highly successful in returning patients to baseline functional status with minimal to no long-term pain. Complete lesion healing and graft incorporation was not always accomplished, but the reconstruction provided adequate structural integrity for return to normal activity utilizing the allograft strut as intramedullary fixation rather than using metal implants for structural support.

161. Serum Protein Electrophoresis Lacks Sensitivity and Specificity for Diagnosis of Multiple Myeloma

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BACKGROUND: Serum protein electrophoresis (SPEP) is often obtained at the initial evaluation of a radiolucent bone lesion prior to a tissue biopsy; and, when negative, considered convincing evidence that the patient does not have myeloma. To our knowledge, the sensitivity and specificity of SPEP have not been previously reported for this clinical scenario. We hypothesized that the SPEP has limited diagnostic value and should not be used as a definitive test for eliminating myeloma as the cause of radiolucent bone lesions of unknown etiology.

METHODS: We searched our institutional database and identified 182 patients undergoing evaluation of a radiolucent bone lesion that included tissue biopsy and an SPEP value. We created simple 2x2 tables to calculate the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of SPEP as a diagnostic test for myeloma in this clinical scenario.

RESULTS: Forty-six of 182 (25.3%) patients in our series had multiple myeloma or plasmacytoma. The sensitivity of the SPEP was 71% and the specificity was 83%. PPV was 59% and NPV was 90%. When analyzing only patients presenting with multiple lesions, the likelihood of multiple myeloma increased to 44.7% (34 of 76 patients). The SPEP, however, did not have a substantially increased diagnostic accuracy with sensitivity of 71%, specificity 79%, PPV 73%, and NPV 77%. The diagnosis of a plasma cell neoplasm was accurately made in all cases on histology alone without knowledge of the SPEP result.

DISCUSSION: In the clinical scenario of a radiolucent bone lesion of unknown etiology, the SPEP positive predictive value is low and the result does not aid in making the diagnosis. We conclude that SPEP lacks specificity and sensitivity for the diagnosis of myeloma in radiolucent bone lesions, and, therefore, recommend that it not be ordered until the diagnosis is suspected or confirmed.

162. Reconstruction of the Proximal Humerus for Bone Neoplasm Using an Anatomic Prosthesis-Bone Graft Composite

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HYPOTHESIS: Limb sparing bone tumor resections of the proximal humerus and reconstruction are effective from an oncologic perspective with modest clinical and functional outcomes.

METHODS: Thirty patients had an intra-articular proximal humerus resection with reconstruction using an anatomic prosthesis-bone graft composite. Twenty-seven patients with an average age of 44 years had an average clinical follow-up of 6.3 years (range 1.3-15.8 years). Diagnoses included bone sarcomas in 19, aggressive benign lesions in 4, and metastatic or hematogenous lesions in 4.

RESULTS: There were three deaths associated with metastatic lesions to the shoulder and three unrelated to the shoulder lesion or surgery. Twenty-two shoulders (81%) had pain relief. Active elevation averaged 62°, external rotation 25°, and internal rotation to L5. Nineteen of 25 patients responding (76%) were satisfied. Using the Neer limited goals rating, 19 (70%) were successful. Complications included clinical instability in 7, nonunion in 4 with implant loosening in 3 of these, and tumor recurrence in 1. There were 7 reoperations including treatment for loosening in 2 and amputation for tumor recurrence in 1. The Musculoskeletal Tumor Society Score averaged 18.3 (61%), the American Shoulder and Elbow Surgeons functional score 18.4 (37%), the American Shoulder and Elbow Surgeons total score 52.2 (52%), and on the Simple Shoulder Test, 5.4 of 12 questions were answered affirmatively.

CONCLUSIONS: This procedure is oncologically safe. Functional ratings are between one-third and one-half of normal.

163. Acute Compartment Syndrome After Intramedullary Fixation of Pediatric Diaphyseal Forearm Fractures

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SUMMARY: Compartment syndrome (CS) is uncommon after intramedullary (IM) nailing of pediatric forearm fractures and is more common after open fractures and in patients with longer operative time.

METHODS: In this retrospective case series, we reviewed patients treated for radius and ulnar shaft fractures from 2000-2009 and identified 113 patients who had IM fixation of both bone forearm fractures. There were 74 closed fractures and 39 open fractures including 31 grade I, 7 grade II, and 1 grade IIIA. We compared patients who did and did not develop CS to find variables associated with this complication. Indications for IM fixation included presence of an open fracture or inability to obtain/maintain an acceptable reduction. If passing the IM nail across the fracture was difficult, a small open approach was used.

RESULTS: CS occurred in three patients (2.7%). CS occurred in 7.7% (3/39) of open fractures and 0% (0/74) of closed fractures (p=0.039), including 45 closed fractures treated within 24 hours of injury. An open reduction was performed in all of the open fractures and 38 (51.4%) of the closed fractures. Longer operative time was associated with developing CS postoperatively (168 vs. 77 min, p<0.001). CS occurred in the first 24 postoperative hours in each case. Each patient required three further operations until final wound coverage or closure.

CONCLUSION: CS was uncommon after IM fixation of pediatric forearm fractures. Open fractures and longer operative times were associated with developing CS. Prior studies have reported higher risk of CS in patients treated with IM nailing within 24 hours of injury, but this was not corroborated in our study. Zero of 45 patients who had IM nailing of closed fractures within 24 hours of injury developed CS; however, 51% of these patients required a small open approach to aid reduction and nail passage. No closed fracture treated with IM fixation in this series developed CS, compared with 10% in other series. Using a small open approach, thus avoiding multiple reduction attempts, may lead to less soft tissue trauma and lower risk of CS. We advise a low threshold for converting to open reduction when closed reduction is difficult.

164. Septic Arthritis in Children Less Than Three Months of Age (A Retrospective Review)

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INTRODUCTION: Septic arthritis in children less than three months of age is a rare condition that can be difficult to diagnose. Their immune systems often mount an insufficient response to be detected, and early intervention is required to avoid potentially devastating sequelae such as joint destruction and limb length inequality.

METHODS: A query of hospital records from 1994 through 2010 was performed to identify all patients less than three months of age at the time of diagnosis of septic arthritis. Medical records were retrospectively reviewed to analyze birth history, joint involvement, physical examination findings, lab work, imaging results, method of treatment, and outcome.

DATA AND RESULTS: Our query identified 14 children that met the criteria that had complete hospital records for review. Average age was 42.2 days. Joints involved were knee (8), hip (3), and shoulder (3). The most common physical examination findings were tenderness (100%), decreased ROM (100%), swelling (71.4%), and erythema (35.7%). Average findings included temperature 38.5ºC, WBC18.5 (34.8% neutrophils, 11.1 bands), ESR 48.9, and CRP 6.1. 57.1% of joint aspirates had positive cultures, 41.7% of blood cultures were positive. Of the joint cultures that did not grow an organism, 66.7% had received an antibiotic prior to aspiration. Causative organisms included Group B Strep (5), MSSA (4), H. influenza (1), Strep. pneumo (1), Salmonella (1), Candida albicans (1), and unknown (1). A review of the imaging used during diagnostic workup revealed 50% of x-rays, and 28.6% of ultrasounds were read as normal. 28.6% had osteomyelitis adjacent to the joint of involvement. Initial method of treatment included I&D (5), aspiration (7), and observation (2). 71.4% of initial treatments were definitive. 20% of initial I&Ds required repeat I&D. 42.9% of initial aspirations required later I&D. 50% of initial observation required later I&D.

DISCUSSION: The most common physical examination findings in children less than three months of age with septic arthritis are tenderness, decreased ROM, and swelling. Labs most likely to be elevated are WBC >12.0, and CRP >2.0.

165. Pediatric Osteoid Osteomas Not Amenable to Radiofrequency Ablation: A Retrospective Review of Surgical Outcomes

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INTRODUCTION: Osteoid Osteomas (OOs) are now commonly treated with radiofrequency ablation. Those near neurovascular or articular structures often require surgical management. Seventy-five percent of OO patients are less than 25 years old. This study examines symptom resolution, recurrence rates, and diagnostic confirmation for pediatric patients with surgically managed pelvic and appendicular lesions at a single institution.

METHODS: Sixty-five patients were treated surgically for lesions concerning for OO at our institution between January 1995 and December 2009; 28 (43.1%) were pediatric patients with a mean age of 13.4 years (range 5-18 years). Cases were reviewed retrospectively after an average follow-up of 8.8 years (range 1.5-15.4 years). Presentation, diagnosis, and histological confirmation were assessed through clinical, operative, and pathology notes. Pain relief and recurrences were identified through clinical notes and patient phone interviews. Symptom resolution was defined as complete cessation of pre-surgical discomfort. Outcomes were compared between patients with a documented OO pathologic confirmation, CT-guided lesion localization, prior surgical treatment, hand/wrist lesions, and complex presentations (defined by extensive prior work-up, multiple prior surgeries, or a high degree of diagnostic uncertainty). Associations were evaluated using JMP statistical software to run two-tailed Fisher's exact tests and College of St. Benedict and St. John's University on-line exact RxC contingency tables.

RESULTS: Nineteen males (67.9%) and nine females (32.1%) were treated at a mean age of 13.4 years (range 5-18 years). Excision and curettage were performed in all patients. Eighteen patients (64.3%) had complex presentations; 4 patients (14.3%) had prior surgical treatment, 4 patients (14.3%) had lesions of the hand/wrist, and CT-guided needle localization was used for 6 patients (21.4%). Confirmatory pathology was obtained for 23 patients (82.1%). Twenty patients (77%) had images confirming nidus removal.

Twenty-five patients (96.2%) experienced complete symptom resolution during the study period. Symptom resolution occurred in less than 2 weeks for 15 (62.5%) patients, 2-6 weeks for 2 (8.3%) patients, 6-12 weeks for 4 (16.7%) patients, and in 12 weeks or more for 3 (12.5%) patients. Four patients had recurrences (14.8%); 3 patients (11.1%) required further interventions.

CONCLUSIONS: Prompt and lasting symptom relief is possible in the surgical management of pediatric osteoid osteomas that are not amenable to radiofrequency ablation. CT-guided lesion localization, pathologic confirmation, radiographic confirmation of nidus removal, previous surgeries, and complex presentations did not affect outcomes.

166. A Prospective Evaluation of Post-Traumatic Stress Disorder and Parent Stress in Children with Orthopedic Injuries

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BACKGROUND: Trauma has more than physical effects on pediatric patients and their families. The purpose of this study was to evaluate pediatric orthopedic trauma patients and patients with isolated nonoperative upper extremity fractures for emotional/psychological symptoms associated with post-traumatic stress disorder (PTSD) and parent stress.

METHODS: An IRB-approved prospective study of patients age 8-18 who sustained a traumatic injury or isolated upper extremity fracture from October 2009 to May 2010 was performed. Demographic data was obtained and The Child PTSD Symptom Scale was utilized. The Parent Stress Index was utilized to evaluate the stress of the parents/guardian. For 80% power, we needed 32 children per group. P value was set at < 0.05.

RESULTS: A total of 76 children and their parent/guardian participated in the study. The mean age was 12.6 years (8-17 years). There were 56 males (74%) and 20 females (26%). The average time since injury was 12 months (3-89 months). The prevalence of PTSD between the high-energy trauma patients and the low energy nonoperative upper extremity patients was not significant, $p=0.22$. Overall, 32.9% of the children had PTSD. Involvement in music was significant between patients with and without PTSD ($p=0.037$) and may be protective against PTSD.

CONCLUSIONS: PTSD commonly affects pediatric patients who sustain injuries as a result of a traumatic event, whether low or high-energy mechanisms. We found no factors significantly associated with or predictive of PTSD. We need to have a high index of suspicion in all pediatric trauma patients regardless of the energy associated with the traumatic event.

167. Neglect and Diagnostic Delay of Malignant Soft Tissue Tumors

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Attempts to improve the time to diagnosis have been made by producing guidelines for urgent referral. However, there is no evidence to show that those patients who are diagnosed and treated earlier are conferred a prognostic advantage. In fact, it has been suggested that those patients who present earlier tend to have high-grade disease and have a less favorable outcome. The purpose of this study is to detail causes of failure or delay in patient referral patterns to a cancer specialist, and to assess whether delay or neglect has any impact on patient survival and limb salvage options. Furthermore, the study aims to identify patient demographics and tumor characteristics that may put patients at higher risk for a delayed referral to a specialist. Between January 2003 and January 2007, 194 patients with a confirmed diagnosis of soft tissue sarcoma were treated by the sections of orthopedic and surgical oncology a comprehensive cancer center. Standard demographic information, including age, sex, highest level of education, employment and insurance status, was collected via the database. Histological diagnosis, size of tumor at presentation, and timing of referral from first noticing the mass to presentation to a SS were recorded. Specific causes for referral delays in each medical or surgical specialty were evaluated in order to identify trends. The mean time for a patient to be referred to the specialist from the onset of symptoms was 9.3 months (range: 0.5-65 months). Only 14.6% were sub-categorized into the *Timely* group (<3 months to be referred from onset of mass), 20.4% in the *Delayed group* (3-12 months to be referred from onset of mass) and 65% in the *Neglected* group (>1 year to be referred from the time of symptom onset). Medical student education concerning the initial management of soft tissue malignancies is crucial to decreasing referral time for patients with these often devastating tumors. Optimizing communication among clinicians, radiologists, and pathologists cannot be overemphasized and can avoid many inadvertent diagnostic errors.

168. Analysis of Three-Tesia Magnetic Resonance Imaging for Diagnosis of Intra-Articular Knee Injuries in Children and Teenagers

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INTRODUCTION: Magnetic resonance imaging (MRI) is a commonly used tool for the diagnosis of intra-articular knee pathologies. While many studies have reported on the accuracy of MRI in the adult population, fewer studies have investigated these tests in younger patients. These studies have shown a higher variability in both the sensitivity and specificity of MRI for these knee injuries in this age group. Advancements in MRI technology, such as the 3-Tesla (3T) MRI magnet, have shown promising results for musculoskeletal injury diagnosis in adults. However, this 3T MRI technology has not been investigated as extensively in children and teenagers. This study aims to analyze 3T MRI for diagnosis of intra-articular knee pathologies in the pediatric and adolescent patient population.

METHODS: The records of 116 patients (119 limbs) under the age of 20 who underwent 3T MRI studies of the knee then subsequent knee arthroscopy were reviewed. The MRI report from the staff musculoskeletal radiologist (MSKR), the interpretation from the staff orthopedic surgeon, and the operative note dictations were then compared, with a focus on meniscus and anterior cruciate ligament (ACL) pathologies. Seventeen orthopedic staff reads were not obtainable. Arthroscopy was used as the gold standard for diagnosis.

RESULTS: Average age at MRI exam was 16.0 and at surgery was 16.2 years old. Using the MSKR interpretation, the sensitivity and specificity of 3T MRI was of 81% and 90.9% for medial meniscus injuries, 68.8% and 93% for lateral meniscus injuries, and 97.9% and 98.6% for ACL injuries. Orthopedic surgeon interpretation of 3T MRI had sensitivity and specificity of 75.7% and 92.4% for medial meniscus injuries, 69.8% and 98.3% for lateral meniscus injuries, and 100% and 98.6% for ACL injuries. Posterior horn tears had the greatest discrepancies.

CONCLUSIONS: When performed on pediatric and adolescent patients, newer 3T MRI studies have excellent accuracy for diagnosing ACL tears. These studies also show higher accuracy for diagnosis of medial meniscal tears than lateral meniscal tears.

169. Ultrasound Evaluation of Ulnar Nerve Stability in the Pediatric Population

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Supracondylar humerus fractures are common injuries in children and are often treated by closed reduction and percutaneous pinning. Ulnar nerve instability can lead to nerve complications or damage when medial pins are used. This has led to treatment of elbow fractures with lateral pins only, a biomechanically less stable fixation technique than medial and lateral pins. The objective of our study was to use ultrasonography to determine the extent of ulnar nerve dislocation in the normal pediatric population.

Fifty-two children (103 elbows) were evaluated by dynamic ultrasound the excursion of the ulnar nerve through a range of motion was documented. Based upon its movement during flexion, the ulnar nerve was categorized as stable, subluxing, or dislocating. In addition, we assessed all subjects for ligamentous laxity using the Wynne-Davies signs of joint laxity.

Most of the elbows evaluated had stable ulnar nerves (65/103, 63.1%). The next most common variation was subluxing nerve (28/103, 27.2%). The rate of dislocating nerves was 10/103 (9.7%). Patients aged 6-10 showed the highest rate of dislocating or subluxing nerves, with 50% (10/20) of this age group having an unstable nerve. We found that 42.9% (6/14) of patients aged 0-5 years had unstable nerves, while 27.8% (5/18) of those aged 11-18 showed subluxing or dislocating nerves.

When patients were grouped according to ligamentous laxity, patients who had multiple signs of ligamentous instability (a laxity score of 3-5) had statistically higher numbers of subluxing and dislocating nerves (25.6%, 10/39) than those with lower laxity scores (84.6%, 11/13).

The rate of dislocating ulnar nerves in our study is lower than previously reported in the literature. There are, however, a significant number of subluxing nerves and the incidence is often bilateral. Therefore, there is a need for increased vigilance intraoperatively during fixation of elbow fractures in order to prevent ulnar nerve damage.

MAOA BREAKOUT SESSION #14
HIP MOM/COMPLICATIONS
April 21, 2012

170. Multicenter Mid-Term Study of a Modular Metal-on-Metal Total Hip Arthroplasty

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BACKGROUND: In recent years, metal-on-metal (MOM) hip arthroplasty has come under fire in the scientific literature. With reported adverse outcomes of metal hypersensitivity, pseudotumors, aseptic lymphocytic-vasculitis-associated lesions (ALVAL), and the carcinogenicity concern from systemic metal ions, there has been a decrease in the use of MOM arthroplasty. The debate of the ideal bearing surface continues. We present three center's data using a modular MOM total hip arthroplasty in patients with a follow-up of five to ten years.

METHODS: Retrospective analysis of 337 primary total hip arthroplasty patients from three independent centers was performed at a minimum 5-year follow-up (range 5-9 years). All cases were performed or supervised by an adult reconstruction fellowship-trained senior surgeon using the Ultimet articulation with Summit/Pinnacle components. Harris Hip Scores (HHS) and radiographic data were collected, as well as any complications and revision for any reason. Radiographic parameters included cup position and incidence of radiolucent lines and osteolysis. Metal ion levels were measured only if clinically indicated.

RESULTS: Average HHS improved significantly from 52 preoperatively to 93 postoperatively. Nine patients (2.9%) underwent component revision. Reasons for revision were infection (n=3), dislocation (n=1), aseptic loosening (n=2), squeaking (n=1), and two for unexplained hip pain (n=2); these two patients had formal metallosis work-up. Of the two patients, one patient had elevated metal ions, and one patient had normal ion levels. Both patients had no gross or histologic sign of metallosis or soft tissue reaction.

CONCLUSION: Our MOM patients show good to excellent outcomes at 5-9 years with a 2.9% incidence of revision for any reason. 0.6% of patients were revised for unexplained pain for which no clear metal reaction was observed. Longer-term follow-up is warranted, but our mid-term results show that this modular MOM total hip still offers a promising bearing articulation in the correct patient population.

171. Metal-on-Metal Bearings in Cementless Total Hip Arthroplasty at 3 to 5 Year Follow-Up

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INTRODUCTION: Concerns have arisen regarding metal-on-metal total hip replacement. The purpose of this study was to examine the 3 to 5 year follow-up of a consecutive series of metal-on-metal THAs using a modular metal shell with supplemental screw fixation.

METHODS: 168 consecutive metal-on-metal THAs were performed in 148 patients using a cementless acetabular component. Average age at surgery was 51.6 years (range, 25 to 69). Average BMI was 37. Patients were evaluated at 3 to 5 year follow-up with Harris Hip, UCLA, SF-36, and WOMAC ratings. Radiographs were evaluated for loosening and osteolysis.

RESULTS: The average follow-up Harris Hip score was 93, and the average UCLA activity score was 4.8 for the 163 hips in 143 living patients. Minimum 3-year radiographs were obtained on 83.5% of hips in living patients (137 of 163 hips). One femoral component was revised for loosening, and one femoral component demonstrated fibrous fixation. All other femoral components and all acetabular components demonstrated radiographic evidence of ingrowth fixation. Osteolysis of less than 1 cm squared was detected around five femoral components and three acetabular components. No hips were revised for concerns of metal toxicity or adverse tissue response.

DISCUSSION: At 3 to 5 year follow-up of this THA construct with a metal-on-metal bearing, there was one revision for femoral loosening, but nonrelated to metal toxicity or adverse tissue response to metal. This may be related to the modular acetabular component which allowed supplemental screw fixation and more controlled positioning of the acetabular components.

172. Metal-on-Metal Components in Total Hip Arthroplasty: A Case Series

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In light of the current interest surrounding metal-on-metal (MOM) components in total hip arthroplasty (THA), it is important to evaluate these devices in clinical as well as experimental settings. This case series consists of 282 patients who underwent total hip arthroplasty with metal-on-metal components from 2001 to 2009. All metal liners were from the same company and product line, and a single surgeon performed all THAs.

Of these patients, three patients had to have partial or total revisions of their hip. Two patients had a head and liner exchange for possible sepsis. The third patient had a stem revision after an accident and went on to have an irrigation and debridement for soft tissue necrosis. None of the liners were replaced with another metal component.

For the 145 patients that had completed at least a two-year follow-up, the average follow-up was four years. From their preoperative assessment to their latest follow-up, 89% of patients reported an improvement in pain score (N=114). Seventy-one percent of patients reported an improvement in their preoperative limp (if present, N=129). Out of the 103 patients who reported satisfaction scores, no patient was unsatisfied with their surgery. The majority (66%) reported that they were “extremely satisfied”.

This case series represents an instance where MOM components provided good results. However, there were a few patients who required an irrigation and debridement for possible sepsis. In at least one of these cases, metal ion sensitivity was a likely culprit.

173. Comparison of Early Adverse Outcomes Between Total Hip Arthroplasty and Hip Resurfacing

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Gregory Strnda, B.S.	Cleveland, OH
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INTRODUCTION: Safety of hip resurfacing (HR) procedures is a concern. Some reports have documented increased adverse outcomes (i.e., readmission and reoperation) of HR when compared to total hip arthroplasty (THA). We hypothesized that early adverse outcomes such as increased length of stay (LOS) with discharge disposition to an assisted facility instead of home, readmission, reoperation, and incidence of infection are similar or lower for patients treated with HR when compared with THA.

METHODS: All consecutive cases of HR or THA for OA during 2009-2010 were extracted from administrative databases and electronic medical records based on the combination of ICD9 and CPT codes. Demographics, LOS, discharge disposition (home or assisted facility), incidence of infection within one year, and readmission and/or reoperation for all reasons within 30 days of surgery were collected.

RESULTS: 1,217 patients underwent THA procedures and 493 underwent HR procedures. Demographic parameters of the two cohorts were different: average age was 64±12 years for THA and 54±8 years for HR patients ($p<0.001$); male percentage was higher in the HR (70%) than in the THA cohort (44%) ($p=<.0001$). Average LOS was similar between cohorts (3.8 and 3.3 days for THA and HR, respectively). Discharge disposition was significantly different between THA (home 45% vs. assisted facility 55%) and HR (home 91% vs. assisted facility 9%) ($p=<0.001$). Thirty-day readmission rate for THA patients was 4% compared to 1.4% for HR ($p=0.001$). Thirty-day reoperation rate for THA patients was 2% compared to 0.2% for HR ($p=0.006$). One-year infection rate for THA was 0.6% compared to 0.9% for HR ($p=0.6$). Significant difference between groups was found even with adjustment for age and gender.

CONCLUSION: Early adverse outcomes including disposition to an assisted facility instead of home, readmission, reoperation, and infection were less frequent after HR when compared to THA. More adjustment may be needed to accommodate for demographic differences between the two cohorts at baseline.

174. Effect of a Second Joint Replacement on Metal Ion Levels After Primary Total Hip Arthroplasty

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INTRODUCTION/PURPOSE: It has been established that serum metal ion levels are increased after primary total hip arthroplasty (THA) regardless of the bearing surface. Several modes of metal ion release exist including passive dissolution, wear (mechanical), corrosion (electrochemical), and combined processes (fretting). Prior studies have described sources and increased metal ion levels of titanium, cobalt, and chromium after primary metal-on-polyethylene THA. Degenerative joint disease of the hip often impacts the contralateral hip and knee, necessitating a future total joint arthroplasty (TJA). The purpose of this study was to determine the effect of this second arthroplasty on existing serum metal ion levels at long-term follow-up.

MATERIALS AND METHODS: Twelve patients (average: 63.4 years old, range: 55-76) were included in this study which was approved by the hospital Institutional Review Board. Four males and eight females undergoing initial primary metal-on-polyethylene THA were included. There were eight subsequent THAs and four total knee arthroplasties (TKA) at average of 102.7 months (range: 36-144 months) after the initial surgery. Secondary THAs consisted of five hybrid constructs and three cementless reconstructions. In five of the eight THAs, supplemental titanium screws were utilized to secure the acetabulum. All TKAs were cemented in place with a cobalt-chrome femur and a titanium tibial tray.

Blood samples were collected preoperatively and at 3, 6, 12 months, and yearly thereafter. Serum samples were analyzed for cobalt, chromium, and titanium using high resolution sector field ICPMS (Element 2, Thermo/Finnigan, Germany) with detection limits of 0.2 ng/ml for Ti, 0.015 ng/ml for Cr and 0.04 ng/ml for Co. Collective data for the initial THA group was compared to patients undergoing a TKA or a THA separately and then combined. Friedman tests were performed to determine statistical significance with a $p > 0.05$ as the threshold for significance.

RESULTS: Five-year data was available for all 12 patients after the second TJA (average follow-up: 96.4 months, range: 61-168). Patients undergoing secondary TKA had no significant differences in cobalt, chromium, or titanium ion levels up to 72 months after surgery. Patients with secondary THA had significantly elevated cobalt ion levels at 12 and 48 months, chromium ion levels at 12 and 24 months, and titanium levels at 48 and 72 months. Combining all patients, chromium ion levels were significantly elevated at 12 months and titanium levels at 72 months after the second TJA. Second metal-polyethylene THA resulted in elevation of all metal ion levels tested at all time points.

CONCLUSIONS: Elevation of metal ions after primary THA is well-documented, but the effect of secondary TJA on these levels has not been thoroughly investigated. The key finding of this study is that metal ion levels did not increase as much when a patient had a TKA following a primary THA compared to when they underwent a second THA. Absence of a modular taper in knee replacements suggests that corrosion at the head-neck junction and/or fretting at the screw-cup interface may be responsible for the elevated metal ion levels observed after a THA and not a secondary TKA. Larger numbers and longer-term follow-up are necessary to determine the extent and impact of these elevated metal ion levels.

175. Comparison of Symptoms and Function Following THA vs. Surface Replacement in Young Active Patients

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INTRODUCTION: Patient satisfaction is not always met after total hip arthroplasty (THA); areas of complaints by young active patients include limp, limb length discrepancy, thigh pain, and painful ambulation. Potential suggested advantages of surface replacement arthroplasty (SRA) over THA include less thigh pain, less limb length discrepancy, and higher function. To date, these perceived advantages have not been evaluated in the literature. A multicenter survey study was conducted to determine if there was evidence to support these potential benefits.

METHODS: Multicenter study of hip specialists with well established joint registries reviewed to compile a consecutive series of patients ≤ 60 years old with a pre-morbid UCLA activity score ≥ 6. Patients were evaluated at one to three years following cementless THA with an advanced bearing surface (n=682) and compared to a demographically similar group of patients with SRA (n=124). Questionnaires were administered by an independent survey center specializing in health care data collection, independent of the surgeons and with no knowledge of the patient's implants. Multivariate analysis was conducted to compare bearing surface and femoral head size with outcomes of THA and SRA.

RESULTS: SRA patients had a higher incidence of complete absence of any limp (despite having a larger surgical incision; $p<0.0001$), lower incidence of thigh pain ($p=0.0004$), lower incidence of perception of limb length discrepancy ($p=0.016$), greater ability to walk continuously for more than 60 minutes ($p=0.008$), higher percentage that ran after surgery ($p=0.001$), greater distance run ($p=0.0001$), and less difficulty performing their most favored recreational activity ($p=0.0166$).

DISCUSSION AND CONCLUSION: SRA patients exhibited higher levels of function with less symptoms and less perception of limb length discrepancy compared to a similar cohort of young active THA patients. Continued utilization of SRA in the appropriate patient population is justified, but longer follow-up is necessary to determine functional outcomes over time.

176. The Impact of Weightbearing on Acetabular Component Inclination and Version Following Hip Arthroplasty

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(Presented by Muyibat A. Adelani, M.D, St. Louis, MO)

INTRODUCTION: The outcome of hard-on-hard bearings, especially metal-metal, has been highly correlated with the position of the acetabular component. Supine imaging with conventional radiography has traditionally been utilized to assess component inclination (abduction) as well as anteversion following hip arthroplasty (THA and surface replacement or SRA). Most adverse events with hard bearings (excessive wear and squeaking) occur with loading. Weightbearing imaging, therefore, should be advantageous.

MATERIALS AND METHODS: Simultaneous biplanar weightbearing imaging of the lower extremity with a low radiation collimated beam was performed on 46 arthroplasty patients (23 THA, 23 SRA). The THA patients had previously had standard CT scan performed. The supine anteversion measured by CT was compared to the functional weightbearing anteversion computed from three dimensional weightbearing imaging. For SRA patients, acetabular inclination was compared supine versus weightbearing double limb and weightbearing single limb.

RESULTS: Weightbearing anteversion differed from supine anteversion by >5° for 12 of 23 THA patients (range 5-15.5°). For the SRA patients, 6 of 23 patients exhibited >2° difference in inclination between supine and double limb weightbearing images and 13 of 23 exhibited >2° difference in inclination between supine and single limb weightbearing images (range 2.0-6.9°).

CONCLUSION/DISCUSSION: Weightbearing changes the acetabular inclination and version in a substantial percentage of hip arthroplasty patients. This technology allows imaging of the entire skeleton with 3-D reconstruction. Correlation of the change in position of the pelvis and/or lumbar spine that occurs in the upright position may predict which patients exhibit change in acetabular orientation supine versus weightbearing.

177. Do We Need Pedometer Data to Differentiate Long-Term Function Following Total Hip Replacement?

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INTRODUCTION: As more and more total hip replacement implant designs and bearing surface options have become available and as the cost associated with the procedure is escalating (because of the increased numbers being performed), it is prudent to differentiate the results between designs long-term. The purpose of this study was to evaluate a group of active patients (less than 50 years of age at the time of surgery) who were still actively functioning ten years following their total hip replacement surgery. These patients were evaluated with activity monitors, self-administered rating scales, and six-minute walks.

METHODS: A consecutive series of 50 patients who underwent total hip replacement when they were under 50 years of age and who were followed for at least ten years were included. In this consecutive group, all patients wore activity monitors (accelerometers worn around the ankle, similar to a pedometer) for up to 14 days, performed a six-minute walk, and completed SF-36, WOMAC, Tegner, and UCLA questionnaires. In addition, every patient had a minimum ten-year radiograph along with sequential radiographs.

RESULTS: Mean age at surgery and BMI were 39.3 years and 29.1, respectively. Mean 6-MW distance was 335 meters and pedometer data equaled 1.59 million steps per year. Average UCLA and Tegner Scores were 6.1 and 3.0 respectively. The mean linear wear rate was 0.263 mm/year; the mean volumetric wear rate was 82.6 mm^3/year. The average daily steps were significantly related to linear wear per year ($p=0.0002$) and volumetric wear per year ($p=0.002$). 6-MW, Tegner, and UCLA Scores did not correlate with wear ($p>0.05$).

DISCUSSION: Using acetabular liner wear as the best surrogate for activity, only pedometer activity correlated with wear. Hence, obtaining pedometer data should be considered when trying to distinguish differences in various hip arthroplasty designs and techniques long-term.

178. Total Hip Arthroplasty for Femoral Neck Fracture: Comparing Results to an Elective Patient Population

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INTRODUCTION: Total hip arthroplasty (THA) remains a treatment option for femoral neck fractures. In an elective setting, THA is a successful procedure and can be used as a benchmark with which to compare the results of THA following a fracture.

METHODS: Patients from the National Hospital Discharge Survey treated with a THA for osteoarthritis (OA) and femoral neck fracture (FNF) between 1990-2007 were selected for comparative analysis. The age, preoperative health, postoperative complication rate, postoperative disposition, and mortality rate were examined and compared between groups at six-year intervals (1990-1995, 1996-2001, and 2002-2007).

RESULTS: A total of 2,160,061 primary THA procedures were performed for OA, while 174,641 were performed for FNF. There was a difference in the mean age between the two groups, which was 68 and 79, respectively. The perioperative mortality rates following elective and post-traumatic THA were 0.2% and 1.7% for the first interval, 0.1% and 2.9% for the second interval, and 0.3% and 0.8% for the third interval ($p<0.001$). The percentage of patients with diabetes, the length of stay, and the percentage of patients discharging to a rehabilitation facility were higher in the FNF group at each time interval. Acute dislocations were more frequent in the FNF patients during the first and second intervals, but this was not observed during the last time interval**.**

DISCUSSION: In comparison to primary elective THA for OA, THAs performed in patients with a FNF result in higher perioperative mortality rates, longer hospital stays, and a greater need for postoperative inpatient rehabilitation. While once greater in the FNF population, dislocations between the elective and FNF groups have recently equilibrated. This may be due to increased use of larger femoral heads.

179. A Novel Aseptic Protocol Decreases Surgical Site Infections After Primary and Revision Hip Arthroplasty

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INTRODUCTION: Surgical site infection (SSI) is a devastating complication after hip arthroplasty. Previous studies have demonstrated the following as risk factors for SSI: (1) ASA class ≥ 3, (2) BMI > 30, (3) revision arthroplasty, (4) renal insufficiency, and (5) immunodeficiency. Using a novel aseptic protocol, involving a three-phase skin preparation and perioperative treatment with vancomycin and cefazolin, we aim to minimize SSI in a high-risk population.

METHODS: SSI, defined as return to OR and positive culture within 90 days, was investigated in a single surgeon case series of all patients undergoing primary or revision hip arthroplasty from 2005 to 2010. All patients received three-phase skin preparation (4% chlorhexidine-gluconate, 70% isopropyl alcohol, 10% povidone iodine) and pre- and postoperative doses of vancomycin and cefazolin. Three blinded independent reviewers examined SSI risk factors and patients were further stratified mild (≤ 1 risk factor), moderate (2 risk factors) and high risk (≥ 3 risk factors).

RESULTS: Our patient population was higher risk than populations in previously published studies ($p < 0.04$). Seventy percent of patients were ASA Class ≥ 3, 45% had a BMI ≥ 30, and 50% were high risk (≥ 3 risk factors). We found a 0.4% (2/467 patients) SSI rate using our protocol, which is among the lowest in current literature. No independent or grouping of risk factors was associated with increased risk for SSI. Infections in two patients (1 low risk, 1 high risk) occurred with non-skin flora organisms (Pseudomonas and Enterobacter). Both patients demonstrated successful retention of prosthesis with normal serology and osseous integration of femoral and acetabular components at two years follow-up. No patients were lost to follow-up.

CONCLUSION: In a high-risk population of patients undergoing primary and revision hip arthroplasty, our novel aseptic protocol results in a 0.4% SSI rate.

180. Dislocation Risk in Morbidly Obese Total Hip Patients

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INTRODUCTION: Recently, obesity, especially morbid obesity, has been linked to increased rates of dislocation following total hip arthroplasty. Soft tissue engagement caused by increased thigh girth has been proposed as a possible mechanism. Toward the goal of providing quantitative data to help guide surgical management in the morbidly obese, we developed a novel computational model to explore this potential mechanism for instability in the obese total hip patient.

METHODS: The obesity effect was explored using a physically-validated finite element model of total hip hardware and capsular soft tissue. The model was augmented using anatomic and anthropometric data to include eight levels of body mass index (BMI). Parametric computational runs assessed joint stability for two head sizes (28 mm and 36 mm), for normal versus high (8 mm) neck offset, and for 15-cup inclination angles (30°-65°). Physical validation of the obesity effect was conducted using a calibrated pressure-sensing mat to register the magnitude of the thigh-thigh impingement load in obese subjects performing a sit-to-stand maneuver.

RESULTS: Close agreement was achieved between the physical and computational simulations. Computationally, thigh soft tissue impingement was shown to appreciably lower the resistance to dislocation for BMIs of 40 or greater. Dislocation risk increased above this threshold as a function of cup abduction angle, independent of hardware impingement. Increased head diameter did not substantially improve joint stability. High offset necks, however, resulted in significantly decreased dislocation risk.

DISCUSSION: This finite element formulation provides a novel framework for systematic analysis of numerous surgical and patient factors affecting stability in the morbidly obese. While dislocation risk in such patients can be influenced by hardware variables such as head size and cup geometry, the clearest avenues toward reducing dislocation risk in the morbidly obese are through usage of high offset stems, and avoidance of high cup inclination.

181. Tranexamic Acid Reduces Need for Transfusion in Primary Total Hip Arthroplasty♦

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Total hip arthroplasty is associated with significant blood loss often requiring allogeniec blood transfusion. Blood transfusion is both costly and carries increased risk of perioperative complications. Tranexamic acid is an anti-fibrinolytic agent that has been used to decrease blood loss in cardiac and orthopedic surgery.

We retrospectively reviewed the records of 290 patients who underwent primary total hip arthroplasty and received a two-dose protocol (10mg/kg) of tranexamic acid intravenously and compared them to 255 patients who did not. We compared the transfusion rate, change in hematocrit, hospital length of stay, and number of units transfused per case between the two groups**.**

In the treatment group, 59/290 (20.3%) required transfusion with 1.86 units of PRBCs transfused per case. Their average preoperative hct was 41.2%, post-procedure 34.7%, and pre-discharge 30.2%. Their average length of stay was 2.3 days.

In the control group, 87/255 (34.12%) required transfusion with 2.2 units per case. The average preoperative hct was 40.1, post-procedure 32.2, and pre-discharge 28.4. Their average length of stay was 2.7 days.

Our data suggests that a two-dose protocol of tranexamic acid decreases the need for transfusion in primary total hip arthroplasty.

182. Wound Complications in Joint Arthroplasty: Evaluation of a Unidirectional Barbed Suture for Skin Closure

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INTRODUCTION: Various methods of skin closure exist in joint replacement surgery. While subcuticular skin closure techniques offer an aesthetic advantage to conventional skin stapling, no measurable differences have been reported. Furthermore, newer barbed sutures, such as the V-loc absorbable suture, theoretically distribute tension evenly through the wound and help decrease knot-related complications. We hypothesize that despite theoretical gains, skin closure in joint arthroplasty with a V-loc absorbable suture should be performed with caution.

METHODS AND MATERIALS: A retrospective chart review was conducted of 278 consecutive primary joint reconstruction cases performed by a single surgeon from July 2009 through June 2010. Wounds were closed via staple gun or subcuticular stitch (3-0 Biosyn vs. V-Loc) in a consecutive manner, depending on the surgeon's preference in that period. The cohort consisted of 106 males and 161 females at an average age of 63 years (range: 18-92). Overall, there were 153 procedures at the knee and 125 procedures at the hip.

RESULTS: There were 17 (6.1%) postoperative wound complications noted, including cellulitis, stitch abscesses, wound dehiscence, and deeper infections requiring OR irrigation and debridement. In 181 cases, staples were used for skin closure; in these cases, seven wound complications were noted (7/181, 3.9%). In 49 cases closed via a subcuticular Biosyn suture, there were four wound complications noted (4/49, 8.1%). Six wound complications occurred in cases closed with a V-loc suture (6/45, 13.3%).

DISCUSSION: Aesthetics and efficiency often are the driving forces of innovation. Based on our clinical experience, we promote consideration of wound and infectious complications when choosing a method of skin closure in joint reconstruction procedures.

MAOA BREAKOUT SESSION #15
SPINE
April 21, 2012

183. Does Prone Re-Positioning Prior to Posterior Fixation Produce Greater Lordosis in Lateral Lumbar Interbody Fusion?

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SUMMARY: A review of intraoperative images in 56 consecutive LLIF cases (88 levels) has shown that lateral to prone re-positioning after LLIF cage insertion does not confer additional operative level lordosis. Segmental lordosis improvement is mainly brought about by cage placement as well as posterior fixation.

INTRODUCTION: LLIF is a new minimally-invasive approach to fusion that is performed in the lateral position; supplemental pedicle screw fixation is often used. While screws may be placed in the lateral position, it is hypothesized that additional lordosis is gained by prone re-positioning prior to screw insertion.

METHODS: We reviewed 56 consecutive patients who underwent LLIF in the lateral position followed by posterior fixation in the prone position. Eighty-eight levels were fused. Disc space angle was measured on intraoperative C-arm images, and change in operative level segmental lordosis brought about by each of the following was determined: (1) cage insertion, (2) prone re-positioning, and (3) posterior instrumentation. Two-tailed t-test was used to determine significance (α=0.05).

RESULTS: Mean lordosis improvement brought about by cage insertion was 2.4° (p=0.0004). There was no mean change in lordosis brought about by lateral to prone positioning (0.0°, p=0.99). Mean lordosis improvement brought about by posterior fixation, including rod compression, was 1.0° (p=0.048).

CONCLUSION: In LLIF procedures, the largest increase in operative level segmental lordosis is brought about by cage insertion. Further lordosis may be gained by placing posterior fixation, including compressive maneuvers. Prone re-positioning after cage placement does not produce any incremental lordosis change. Therefore, posterior fixation may be performed in the lateral position without compromising operative level sagittal alignment.

SIGNIFICANCE: Our results show that prone re-positioning does not produce additional operative level lordosis, and that posterior fixation may be acceptably performed in the lateral position. This will obviate the need for intraoperative patient re-positioning and minimize operative time.

184. Adjuncts in Posterolateral Lumbar Spine Fusion: How Does Recombinant Human Bone Morphogenetic Protein-2 (rhMBP-2) Stack Up to the Gold Standard?♦

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INTRODUCTION: Solid osseous fusion is an integral component of the surgical management of degenerative diseases of the lumbar spine. Because of the large amounts of iliac crest bone autograft (ICBG) needed for posterolateral lumbar fusions, rhBMP-2 in combination with bone void fillers has become popular. The purpose of this study was to compare the complications and efficacy of rhBMP-2, Demineralized Bone Matrix (DBM) DBM, and (ICBG) in posterolateral spine fusion.

METHODS: From 2002 through 2009, all patients undergoing lumbar posterolateral fusion were retrospectively evaluated within a large orthopedic surgery private practice affiliated with a Level 1 teaching trauma center.

RESULTS: 1,398 consecutive patients were evaluated with 575 (41.1%) males and 823 (58.9%) females. Average age was 60 years and BMI was 30.6 kg/m². Mean length of hospital stay was five days. There was no significant difference in length of stay between patients who underwent additional iliac crest bone grafting and those who did not (5.1 days vs. 5.0 days, respectively). 103 patients (7.4%) underwent redo surgery for clinically significant nonunion. The four redo surgeries for bone overgrowth were from the rhBMP-2 group. Significantly less nonunions occurred (4.3%) in the rhBMP-2 group ($\chi^2<0.001$) compared to the DBM or Autograft group (13.1% and 15.2%, respectively). The incidence of seroma formation was higher in the BMP group (3.2%) than in the DBM or autograft group (2.0% and 1.4%, respectively), but this was not statistically significant ($\chi^2=0.286$ and $\chi^2=0.245$, respectively). The overall infection rate was 2.1%, but no statistically significant differences were found between the three groups ($\chi^2=0.488$, $\chi^2=0.739$, and $\chi^2=0.872$, respectively).

CONCLUSION: For posterolateral spinal fusion, iliac crest bone graft has been the gold standard. Additional DBM leads to comparable fusion rates and does not increase infection or seroma formation. rhBMP-2 supplementation instead of ICBG or bone marrow aspirate results in higher fusion rates compared to autograft alone or autograft plus DBM.

185. Recombinant Human Bone Morphogenetic Protein-2 in Posterolateral Spine Fusion: What's the Correct Dose?♦

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INTRODUCTION: The purpose of this study was to define the amount of rhBMP-2 necessary to achieve reliable fusion rates in posterolateral spine fusion by avoiding greater complication rates.

METHODS: From 2002 through 2009, all patients undergoing lumbar posterolateral fusion utilizing rhBMP-2 (INFUSE) were retrospectively evaluated within a large orthopedic surgery private practice.

RESULTS: 1,158 consecutive patients were evaluated with 468 (40.4%) males and 690 (59.6%) females. Average age was 59.2 years and BMI was 30.7 kg/m². Number of levels fused was: 1 (414, 35.8%), 2 (469, 40.5%), 3 (162, 14.0%), 4 (70, 6.0%), 5 (19, 1.6%), 6 (11, 0.9%), 7 (7, 0.6%), 8 (4, 0.3%), and 9 (2, 0.2%). Complications including add on stenosis requiring reoperation were 117/1,158 (10.1%), seroma with acute neural compression 32 (2.8%), excess bone formation with development of neural compression requiring re-decompression 4 (0.3%), infection requiring debridement 26 (2.2%), and symptomatic nonunion requiring redo fusion and instrumentation 41 (3.5%). Nonunion was not related to smoking, number of levels fused, or age. There was an increased risk for nonunion in male patients (5.1% vs. 2.4%, $p<0.05$) and patients with previous BMP exposure (26% vs. 2.4%, $p<0.05$). If exposed to BMP, the relative risk of developing a repeat symptomatic nonunion is 11%. There was no significantly higher nonunion risk for patients who received only 6 mg rhBMP-2/level. Seroma formation was significantly higher in patients with higher total BMP (13.4 vs. 12.5, $t= -1.949$, $p=0.05$) and BMP dose/level (7.7 vs. 6.7, $t=1.985$, $p=0.05$).

CONCLUSION: A systematic literature review showed that the use of BMP in the lumbar spine can be associated with graft resorption, extradiscal, ectopic, and heterotopic bone formation, radiculopathies, epidural cyst formation, and seromas. Based on our findings, we recommend a dosage of 6 mg rhBMP-2 per level for successful instrumented lumbar fusion and decreased risk of postoperative symptomatic seroma formation. Mechanical stability reduces nonunion rate, but does not affect the effective BMP dose.

186. Comparison Between Two Pedicle Screw Constructs in Adolescent Idiopathic Scoliosis Posterior Fusions

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INTRODUCTION: Posterior spinal fusion with pedicle screw instrumentation is the mainstay of surgical treatment for adolescent idiopathic scoliosis (AIS). The most commonly used construct consists of screws placed at every level on the concave side of the deformity and nearly every level on the convex side (consecutive construct). However, some surgeons have begun using constructs with fewer pedicle screws (limited constructs). The purpose of this investigation is to compare the ability of these two constructs to attain and maintain radiographic surgical correction over time.

METHODS: An IRB approved retrospective review of posterior spinal fusions for AIS performed by two surgeons over a two-year period identified 31 cases meeting inclusion criteria. Consecutive constructs were used in 15 cases and limited constructs in 16 cases. Construct characteristics (number of levels fused, number of screws placed) and radiographic measurements (Cobb angles, amount of coronal decompensation, translation of apical vertebrae, and sagittal alignment) were compared preoperatively, two weeks postoperatively, and at the patient's most recent follow-up. Operative time and blood loss were also evaluated.

RESULTS: At final follow-up, there were no significant differences in the coronal Cobb angle of the major curve, percent correction of the instrumented curve, average loss of correction since the two week follow-up, C7 coronal decompensation, translation of the major apical vertebra, sagittal alignment, or operative blood loss when comparing the consecutive and limited groups. Compared to the limited construct group, the consecutive group utilized significantly more pedicle screws (average 18.1 vs. 11.5, $p<0.001$), had longer operative times (average 5 hours 7 minutes vs. 4 hours 23 minutes, $p=0.03$), larger preoperative coronal Cobb angles of the major curve (average 56.1° vs. 50.2°, $p=0.04$), and longer follow-up (average 17 vs. 11 months, $p=0.003$).

CONCLUSION: Excellent curve correction, stability, and balance can be achieved using fewer screws than traditionally used in posterior pedicle screw fusions for AIS. Surgical time is reduced, and risk and implant cost are likely decreased with the limited screw construct approach.

187. The Use of Permanently-Placed Metal Expandable Cages for Vertebral Body Reconstruction in the Surgical Treatment of Spondylodiscitis

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INTRODUCTION: The use of metal implants in the face of infection has classically been discouraged in orthopedic literature because of bacterial biofilms. Thus, the accepted treatment of spondylodiscitis with adjacent osteomyelitis has been aggressive debridement followed by reconstruction with autograft or allograft. With the advent of expandable metallic cages, reconstruction of these defects has been made significantly easier. The purpose of this study is to evaluate the long-term placement of metal cages in patients with spondylodiscitis.

MATERIALS AND METHODS: A retrospective search of our database from 2005-2009 revealed 20 patients that were treated with anterior debridement and reconstruction with an expandable metallic cage. Of these patients, 17 had documented clinical follow-up and, thus, were available for review. Resolution of infection was determined from their laboratory values (ESR, CRP), clinical symptomatology, and final radiographic result. We also determined the pathogen responsible for the infection.

RESULTS: Of the 17 patients with documented clinical follow-up, 100% had clinical resolution of infection with an average time of 11 months. Of all cases, 75% of patients had positive perioperative cultures. The most common pathogens present were MRSA (33%) and MSSA (33%). The most common level of infection was L4-L5 (42%). There was a 2.6° average loss of correction comparing final follow-up radiographs with initial postoperative radiographs. There was no extensive osteolysis noted around the hardware or progressive collapse on any radiograph.

CONCLUSION: It has been our experience that treating spondylodiscitis with metal cages has been effective in resolving symptoms while maintaining overall alignment. The biggest weakness of this study is that it is retrospective. In all cases, a radical debridement of the infection was undertaken and postoperative antibiotics were given according to treatment algorithms for osteomyelitis. The spine appears to provide a unique environment that allows for the use of metal implants in the setting of infection. Our results suggest that we are not perpetuating infection with the use of expandable metal cages.

188. Clinical Decision Making, Differentiating Disabling Sacroiliac Pain from Axial Disc Based Explanations♦

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BACKGROUND: The sacroiliac joint has been defined by many authors as a cause of back and buttock pain. Though thought to be common, the means of diagnosis and accurate differential diagnosis has not been established.

METHODS: The sample consists of 67 SIJ fusions. Sixty-two cases had pre- and postoperative functional data available for comparison. Forty-seven out of 62 cases demonstrated a net functional improvement at last follow-up after surgery, as reflected on the Million Visual Analog Scale. Prior to the decision for surgery, all patients were studied for confirming clinical findings, injection response, and correlation to clinical history. Elements of the decision making process were ranked in order of importance to the final decision for surgery. ANOVA was performed on functional improvement after separating the sample into groups by primary elements of diagnosis.

RESULTS: There was a significant improvement in average Million VAS score (95% confidence interval of 16 to 31 points of improvement), yet no statistically significant association of outcome with any individual subset of clinical findings was found, including history, physical examination, imaging, and diagnostic injection.

CONCLUSIONS: The diagnosis of surgical level SIJ disease and its qualification for surgical approach is a complex series of close history taking, cautious repeated physical examination, and evaluation of other etiologies which could explain the patient's symptoms. The failure of clinical response of lumbar spine surgery to relief of symptoms or improvement, as demonstrated in the SPORT study, should prompt a closer evaluation of the totality of patient symptoms, and sufficient weight (without overemphasis) to all inclusive and exclusionary criteria.

189. Results of Interspinous Decompression for Spinal Stenosis in a Community-Based Hospital Setting

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INTRODUCTION: Symptoms related to lumbar spinal stenosis is a common problem encountered in most spine surgeons practice. Patients with symptomatic spinal stenosis have treatment options that range from conservative (NSAIDs, physical therapy, epidural steroid injection, and bracing) to surgical (decompressive laminectomy with or without fusion and instrumentation). Although surgical intervention can offer improved symptomatic relief over conservative therapy, the risk of a large surgery may be prohibitive in an elderly patient with multiple comorbities. Interspinous decompression has been shown to improve symptoms in such patients, but to date, studies have been done within the confines of large academic centers. Herein, we present our result of interspinous decompression for treatment of NIC in a community-based hospital setting.

METHODS: Retrospective review of 82 patient charts who underwent interspinous decompression for spinal stenosis. We analyzed data related to patient demographics, Oswestry scores, visual analog pain scores for back and leg, complications, and need for further decompressive surgery at two weeks, six months, and at final follow-up.

RESULTS: Data was available on 63 patients. The average age of patients was 58 with 33/63 patients undergoing multilevel interspinous decompression for symptoms related to spinal stenosis. Average Oswestry and VAS scores for leg and back pain were 41, 6.7, and 7.9 respectively, at the time of surgery. At two weeks follow-up, patients had significant improvement in leg and back pain (VAS scores 1.2 and 2.2, respectively). There were two minor complications. At final follow-up (average 15 months), 6/65 (10%) patients had return of their symptoms and received or were recommended further surgery.

CONCLUSIONS: Interspinous decompression has been shown to be both an effective and treatment option for patients suffering from symptoms related to spinal stenosis, particularly those patients in whom major surgery is not ideal. Although the majority of current literature involving interspinous decompression has been done at large academic centers, our data demonstrates its effectiveness by a single surgeon at a community-based hospital. The present data set will hopefully provide evidence and demonstrate its feasibility to the community-based spine surgeon regarding a treatment option for patients with lumbar spinal stenosis.

190. Comparison of Different Posterior Instrumentation Systems in Achieving Stability to Supplement Transforaminal Lumbar Interbody Fusions (TLIFs): A Biomechanical Cadaver Study

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INTRODUCTION: A new minimally invasive device has been approved to fixate two adjacent interspinous (IS) processes after a transforaminal interbody fusion (TLIF).

The purpose of this study is to biomechanically compare different fixation systems for stability supplementation in a TLIF.

METHODS: Seven specimens from T12 to the sacrum were mounted to the testing robot. A stability test was performed, comparing L3-4 intersegmental rotations for the following scenarios: (1) intact spine, (2) TLIF, (3) TLIF with IS Fixation Device [ISD], (4) TLIF with ISD and unilateral pedicle screws, and (5) TLIF with bilateral pedicle screws. The robot applied a continuous pure moment cycle (±5 Nm) in flexion-extension (FE), lateral bending (LB), and axial rotation (AR).

RESULTS: A statistical comparison between the intact spine and the TLIF group showed no significant difference in ROM in FE, LB, or AR. After implantation of the ISD to stabilize the vertebral segment with the TLIF, a significant decrease of 74% in FE ($p=0.00$) was observed in comparison to the intact model; LB and AR were not significantly different from intact. The addition of unilateral pedicle-screw combination with the ISD significantly reduced the ROM by 77% ($p=0.00$), 55% ($p=0.002$), and 42% ($p=0.04$) in FE, LB, and AR respectively in comparison to intact. The bilateral pedicle-screw fixation after TLIF also showed a reduction in ROM of 77% ($p=0.00$) in FE, 77% ($p=0.001$) in LB, and 65% ($p=0.001$) in AR when compared to the intact spine.

CONCLUSIONS: In this study, the ISD stabilized the spine in FE comparably to bilateral pedicle screws. It has, however, minimal stability in LB and AR when attempting to stabilize the segment after a TLIF. ISD with unilateral pedicle screws and bilateral pedicle screws were shown to be statistically equivalent in providing stability in all directions after a TLIF.

191. The Biomechanical Effect of Dynamically Stabilizing the Adjacent Segment to a One Level Lumbar Fusion♦

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INTRODUCTION: One of the many proposed indications for dynamic stabilization is its use as transition instrumentation adjacent to a solid fusion to protect that adjacent level from excessive compensating motion/stress and also aid in creating a smoother motion transition to the other levels of the spine. In this model, we accessed the angular range of motion (ROM) of the adjacent levels of the spine after a L4-5 instrumented fusion. Subsequently, we implanted a pedicle screw dynamic stabilization device at L3-4 and analyzed biomechanically its protective effects on that level as well as the ROM on the remaining segments of the lumbar spine.

METHODS: Seven human specimens T12-sacrum were used. The following scenarios were implemented: (1) intact spine, (2) fusion of L4-5 with bilateral pedicle screws and titanium rods, and (3) supplementation of the L4-5 fusion with a pedicle screw dynamic stabilization construct at L3-L4. The robot applied continuous pure moment (±2 Nm) in flexion-extension (FE) with and without follower load, lateral bending (LB), and axial rotation (AR). Intersegmental rotations of the fused, dynamically stabilized, and adjacent levels were measured and compared.

RESULTS: The rigid construct at L4–L5 caused a 78% decrease in the segment's F/E. It also caused an increase in motion at L1–L2 (45.6%) and L2–L3 (23.2%) (P=0.00). No statistically increase in the ROM was seen at T12-1, L3-4, or L5-S1. The placement of the dynamic construct at L3–L4 decreased the operated level's motion by 80.4% (same stability as the fusion at L4-5) and caused a significant increase in motion at all tested adjacent levels: T12–L1 (73.4%), L1–L2 (85.0%), L2–L3 (49.9%), and L5–S1 (20.8%). The results of F/E with follower load, LB, and AR follow very similar patterns as those of pure FE explained above.

CONCLUSION: The dynamic stabilization system had the same stability as a solid all metal construct. Its addition to the supra adjacent level (L3-4) to the fusion (L4-5) in deed protected the adjacent level from excessive motion. However, it essentially transformed a one-level into a two-level lumbar fusion with exponential transfer of motion to the fewer remaining discs.

192. Core Muscle Size as a Predictor of Kyphoplasty Outcomes

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INTRODUCTION: Single- and multiple-level kyphoplasty is now considered a routine procedure for the treatment of pathologic and non-pathologic vertebral compression fractures. As kyphoplasty is often an elective procedure to alleviate pain, it is imperative that surgeons understand the functional status of their patients to best maximize outcomes. Core muscle size, a proxy measure of patient frailty, may serve as one such variable to help risk stratify patients. Accordingly, we hypothesized that decreased core muscle size would lead to increased mortality as well as increased financial costs to hospitals and payors.

METHODS: We identified 27 non-cancer patients undergoing single- and double-level kyphoplasties between 2004-2010 who had a CT scan of their abdomen within 120 days of their operation. Cross-sectional areas of the left and right psoas muscles at the level of the fourth lumbar vertebra (L4) were measured. Analysis compared mean psoas area to one-year post-operative survival as well as hospital financial charges using data collected for the first 90 post-operative days.

RESULTS: Out of the 27 patients, there were five deaths within one year postoperatively. There was a trend toward significantly lower mean psoas areas of the deceased patients when compared to the patients still alive at one year (615.7 mm^2 vs. 822.4 mm^2, p=.25). The group of patients in the bottom 50th percentile of psoas area trended toward a higher one-year mortality rate when compared to the top 50th percentile (30.8% vs. 7.1%, p=.16). Additionally, with respect to cost, patients in the bottom 50th percentile demonstrated trends toward higher total charges compared to patients in the top 50th percentile ($240,948 vs. $94,322, p=0.39).

CONCLUSIONS: Though our study is underpowered, our data demonstrate trends toward significantly increased mortality rates and health care costs with decreased core muscle size. Such objective measures of patient frailty may potentially inform clinical decision-making and improve selection of candidates for kyphoplasty.

193. Perioperative Complications and Harvest Site Pain Associated with a Minimally Invasive Method for Obtaining Iliac Crest Bone Graft (ICBG) for Anterior Cervical Discectomy and Fusion (ACDF)

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INTRODUCTION: Several articles in the literature report high rates of complication and residual pain after ICBG harvest. In this study, we evaluated the incidence of complications and postoperative pain after ICBG harvest through a new minimally invasive technique.

METHODS: Retrospective review of 68 consecutive patients undergoing up to a three-level ACDF using allograft spacers augmented with ICBG. Plating was performed in all cases. The fusion indications were standard, but a unique, minimally invasive method of harvesting ICBG was used. The harvest incision was always smaller than 1 cm and the graft was obtained through one or multiple cores extracted from the iliac crest with a bone biopsy needle. Chart review and/or a phone interview provided the outcome information needed (complications, graft harvest site pain at six weeks [93% follow-up FU]) and at the final visit (100% FU, mean of five months).

RESULTS: There was a 0% complication rate (0/68) in our series of 68 consecutive patients in whom ICBG was removed through a minimally invasive technique. Significant pain at the harvest site was 0% (0/63) at six weeks and at the final follow-up visit (0/68). Minimal pain at the harvest site was 1.4% at six weeks (1/63) and 0% at final follow-up (0/68).

DISCUSSION AND CONCLUSIONS: ICBG can be harvested safely and with minimal or no pain to fill and/or supplement spacers when performing up to three-level ACDFs. This technique has shown a 0% complication rate, a 1.6% minimal pain rate at six weeks, and 0% minimal or significant pain at final FU at the iliac crest. This study shows results on complication and residual pain rates much smaller than previously reported.

194. Segmental Lumbar Sagittal Correction After Bilateral Transforaminal Lumbar Interbody Fusion

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OBJECTIVE: To determine segmental lumbar sagittal contour change after bilateral transforaminal lumbar interbody fusion (TLIF).

SUMMARY OF BACKGROUND DATA: The importance of lumbar sagittal contour restoration cannot be overemphasized. Currently accepted techniques for restoration of sagittal alignment include Smith-Petersen osteotomies (SPO) and pedicle subtraction osteotomies. There have also been previous reports of sagittal contour correction after unilateral TLIF. Bilateral TLIF with bilateral facet resection for segmental sagittal alignment restoration is a combination of SPO and Shufflebarger's wide posterior release technique, and has great potential for sagittal deformity correction.

METHODS: From March 2007 to October 2010, 42 consecutive patients (57 levels) underwent bilateral TLIF. Standard preoperative and six-week postoperative standing lumbar spine radiographs were examined. Preoperative and postoperative segmental lordosis was determined by manual measurements using the Cobb method. The difference between the preoperative and postoperative values were calculated and analyzed for statistical significance.

RESULTS: The mean preoperative segmental alignment was 8.1°. The mean postoperative alignment was 15.3°, with a mean correction of 7.2° per segment. The largest gain in lordosis was obtained at the L5-S1 level (10.1°). There was a significant difference between the preoperative and postoperative values ($p = 5x10^{-9}$). There was no significant difference in mean segmental correction between levels. Improvement in lordosis was higher in multilevel fusions (9.8°) compared to single level fusions (5.2°) ($p = 0.047$). There was an inverse correlation between preoperative sagittal lordosis measurement and change in lordosis ($r = -0.599$).

CONCLUSION: Bilateral facet resection with posterior compression in TLIF results in significant correction of segmental sagittal plane deformity compared to conventional unilateral TLIF. The technique is less technically demanding when compared with pedicle subtraction osteotomy and avoids complications related to anterior lumbar interbody fusion ALIF.

195. Lordotic vs. Non-Lordotic Cages in Lateral Lumbar Interbody Fusion (LLIF)

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PURPOSE: To compare effects of lordotic versus non-lordotic cages on lumbar sagittal alignment and disc height in lateral lumbar interbody fusion (LLIF).

PATIENTS AND METHODS: This is a comparative radiographic analysis of consecutive LLIF procedures performed with use of lordotic versus non-lordotic interbody cages. Forty-three patients underwent LLIF at 64 levels. Average age was 58 years (30-83). Ten-degree lordotic PEEK cages were used at 33 lumbar interbody levels, and non-lordotic cages were used at 31 levels. The following were measured on x-rays: segmental lordosis at operative level, segmental lordosis at level above and below, anterior and posterior disc heights, and overall lumbar (L1-S1) lordosis. Measurement changes for both groups were compared using paired t-test analysis.

RESULTS: Lordotic cages resulted in a significant increase in lordosis at operative levels ($p=0.03$), whereas non-lordotic cages did not ($p=0.24$). Neither cage group resulted in significant change in supra- and subjacent level lordosis ($p>0.05$ for both groups). Anterior and posterior disk heights were significantly increased in both groups ($p<0.01$ for both groups). Neither cage group showed significant change in overall lumbar lordosis (lordotic $p=0.60$ vs. non-lordotic $p=0.19$).

CONCLUSION: Lordotic cages provided significant increase in segmental lordosis at operative levels compared to non-lordotic cages, although overall lordosis remained unchanged. Anterior and posterior disk heights were significantly increased by both cages, providing basis for indirect spinal decompression.

MAOA POSTER PRESENTATIONS – 2012 ANNUAL MEETING
#1-39

HEALTH SYSTEMS

1. Waste of Component Parts in Total Joint Arthroplasty: A Registry Study

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INTRODUCTION: Limiting intraoperative waste of joint implant components decreases healthcare costs. The purpose of this study was to assess (1) prevalence of waste in primary and revision THA/TKA, (2) reasons for waste, (3) correlation between surgeon volume and waste, and (4) trends in prevalence of waste during the study period.

METHODS: We analyzed 25,798 primary and revision joint arthroplasties (99,900 component parts) performed in our joint registry between September 1991- March 2011 for implant waste. Reason for waste, annual waste incidence, part wasted, waste by surgeon volume, waste by procedure type, and cost of component wasted was noted. Pearson's chi-square tests were used to test differences in waste incidence by surgeon volume and procedure type.

RESULTS: 947 component parts (0.9%) were wasted during the study period. Revision THA (3.0%) and revision TKA (1.5%) had a higher prevalence of wasted parts than primary THA (1.0%) and TKA (0.6%). Acetabular liners were the most frequently wasted part. Wrong component size (58%), dropped parts (12%), and parts damaged upon insertion (6%) were common reasons for wastage, with the surgeon frequently at fault. Surgeon volume did not influence the incidence of wastage. The average cost of the wasted part was $707 (r=$18-$6,871).

CONCLUSION: Surgeon error and wrong size selection were common reasons for wastage irrespective of surgeon volume. The complexity of revision procedures contribute to higher wastage. Given the estimated increase in total joint arthroplasty procedures, substantial costs are associated with this waste.

2. Thirty Day Orthopedic and Rheumatologic Re-Admissions: Retrospective Analysis at a Tertiary Care Medical Center

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BACKGROUND: One of the key areas of focus of many of the healthcare reform initiatives, including those referenced in recent legislative activity, is the need for providers to be accountable, and rewarded, for the quality of care delivered. One quality metric that has received increased attention is re-admission following discharge from an acute care facility, with the consensus that reduction in this key metric will likely yield measurable gains in the quality of outcomes as well as cost savings. The purpose of this study was to investigate those factors that are most closely correlated with 30-day re-admission.

METHODS: An institutional review board approved retrospective review of a comprehensive database of all hospital re-admissions at a major tertiary care medical center was performed over a 12-month period. Those patients who were readmitted were studied for the defining characteristics and the identifiable risk factors most commonly correlated with being readmitted. This cohort was then compared to those of the orthopedic patients who did not require re-admission using a multivariable regression analysis.

RESULTS: 208 (7.2%) of 2,898 inpatient admissions during a 12-month period required re-admission within a 30-day period. 171 (82.2%) of the re-admissions were unplanned, with 83 (48.5%) unplanned re-admissions occurring within seven days from index discharge. Most re-admissions were in patients who had been discharged to home and then presented to the outpatient orthopedic clinic with ongoing problems (58/171, 33.9%). Outside hospital and skilled nursing facility direct transfers accounted for 23.4% (40/171) of unplanned re-admissions. Revision and primary total hip/knee arthroplasty–related index admission DRG codes were most commonly associated with re-admission. The most common diagnosis responsible for re-admission was failure of treatment of a pre-existing surgical site infection, followed by a new onset infection or suspicion of infection.

CONCLUSIONS: Identifying patients at high-risk for hospital re-admission can provide insight into the factors that predispose to this costly and undesirable outcome. Reallocation of resources to identify and provide increased level of services aimed at optimizing patient's co-morbidities in a way that decreases re-admission rates should be a major goal of quality initiatives. Patients who required re-admission within 30 days usually had a complex index clinical course with failure of treatment and/or recurrence of the index problem. Patient co-morbidity, index procedure type, disposition on discharge, and index length of stay all appear to be important predictors of the probability of a 30-day re-admission.

3. Establishing the Process of Routine Outcomes Data Collection in a Comprehensive Orthopedic Center: Critical Steps to Success

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Beginning in 2009, we began the process of routine pre- and postoperative outcomes data collection for five of the most common conditions treated in our comprehensive orthopedic center. These conditions were carpal tunnel release (CTR), ACL reconstruction (ACL), ankle fracture ORIF, rotator cuff repair (RCR), and distal radius fracture ORIF (DRF). The instruments and intervals of patient follow-up are listed in the table below:

Follow-up:

	Outcome	**Follow-up #1**	**Follow-up #2**	**Follow-up #3**
CTR	Boston Carpal Tunnel	2 weeks ± 3 days	6 weeks ± 1 week	3 months** ± 4 weeks
ACL	KOOS	6 months ± 4 weeks	1 year** ± 8 weeks	2 years ± 8 weeks
Ankle Fracture	SMFA	6 weeks ± 1 week	6 months** ± 4 weeks	NA
RCR	WORC	1 year** ± 8 weeks	2 years ± 8 weeks	5 years ± 8 weeks
DRF	Patient Rated Wrist	6 weeks ± 1 week	3 months** ± 4 weeks	NA

** = If outcomes are collected through this point, they are considered complete on that patient. Some of the relevant findings are:

CTR

As of March 2011, we have collected baseline carpal tunnel data on 850 patients, 529 at two weeks postoperative, 338 at six weeks postoperative, and finally, 171 at three months postoperative. By six weeks postoperative, our patients report drastic improvement in both the functional and symptom severity scales.

ACL

We have collected baseline data on 760 patients. By six months postoperative, our patients report drastic improvement in all subscales. There is little to no improvement after the six-month follow-up.

The KOOS sub scales range from 0-100; 0 being worst and 100 being excellent.

	Pain	Symptom	ADL	SportRec	QOL	Total
Baseline	76.88	71.96	85.59	52.28	33.72	72.67
6 months	89.88	77.00	95.05	78.58	64.39	85.90
1 year	90.37	60.03	96.59	78.14	68.60	84.20

Establishing the program requires physician leadership and extensive staff communication, but provides value for surgeons, patients, and payers.

BASIC SCIENCE

4. Establishing Chondrocyte Culture on a Self-Assembled Monolayer

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INTRODUCTION: Surface energy has been shown to influence the behavior of various cell types. There are no known reports of the characterization of the cellular response of chondrocytes to various surface energies. A self-assembled monolayer (SAM) of varying surface energy can be created to define the optimal energy level for maximum cell performance in culture. However, the optimal media formulation to support chondrocyte viability in culture on a SAM is unknown.

METHODS: SAM surfaces were created with octyldimethylchlorosilane on glass cover slips. Fresh human cartilage was obtained from an elective total knee arthroplasty, minced, and isolated by enzymatic digestion. The cells were placed on a SAM surface using one of three media conditions: Opti-MEM only, Opti-MEM with fetal bovine serum, and Opti-MEM with gelatin. Additional chondrocyte surfaces were made using Opti-MEM and polystyrene slides to serve as a control. The samples were cultured and sacrificed at 1, 4, 7, and 14 days for analysis. Immunofluorescent staining was then performed to characterize proliferation and de-differentiation.

RESULTS: The gel surfaces exhibited the highest CD-14/90 ratio at each time point (indicative of greater collagen II production) and greater proliferation at each time point than the Opti-MEM only and control surfaces, but no significant difference was observed with the ANOVA model. There was minimal chondrocyte survival on the fetal bovine serum surfaces.

DISCUSSION/CONCLUSION: Using either the gel or Opti-MEM only media formulations, we successfully cultured human articular chondrocytes on a SAM. Human articular chondrocytes can proliferate and maintain phenotype when cultured in the appropriate media on a self-assembled monolayer. Fetal bovine serum is not an appropriate media to support human articular chondrocyte viability on a SAM. Further research will be directed at defining the optimal surface chemistry to enhance chondrocyte culture in a monolayer to improve both the quantity and quality of ex vivo cartilage tissue used in cartilage restoration procedures.

5. The Effects of Polyethylene Particles at a Weight-Bearing Rat Tibia Bone-Implant Interface

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Osteolysis leading to aseptic loosening is problematic for many total joint arthroplasty patients. The purpose of our study was to evaluate the in vivo effects of polyethylene particles on bone using biomechanics and μ-CT in rats implanted with tibial pins.

Titanium pins were surgically implanted in the tibias of Sprague Dawley rats with either 0.03 ml of 1% rat serum in saline (NRS/PBS; control) or 5 mg/ml UHMWPE (PE) wear particles in NRS/PBS. Pin placement and bone re-growth were measured at 2 and 60 days after surgery using μ-CT. To maintain simulation of wear debris, intra-articular injections of control or PE solutions were performed at two-week intervals. Rats were sacrificed at 60 days. The distal end of the tibia was potted in a custom fixation device axial traction applied using a materials testing machine. Statistical analysis was performed using the student's t-test. A *p* value of less than 0.05 was considered significant.

The rats injected with PE had a significant increase in trabecular separation (0.243 mm and 0.336 mm; p=0.04) and trabecular thickness (0.0530 mm and 0.0703 mm; p=0.03) while a significant decrease in trabecular number (4.124 mm^{-1} and 3.076 mm^{-1}; p=0.02) was also observed comparing baseline to day 60. No significant difference was observed in bone to tissue volume (BV/TV). In control rats, no significant difference was seen in trabecular number, separation, and thickness or BV/TV, versus their baseline. Comparing control rats with those injected with PE at day 60, the PE injected rats had a reduced BV/TV, decreased amount of trabecular bone, thinner trabecular bone, and increased trabecular space; however, these differences were not statistically significant. Regarding pullout testing, although not statistically significant, more force was needed on average to remove the pins implanted in control rats versus PE rats.

Our data indicated that PE particles had a negative effect on bone formation and mechanical stability, based on both quantitative in vivo μ-CT and biomechanical pullout testing.

6. Angular Stable Intramedullary Nail vs. Locking Plate Fixation of Osteoporotic Surgical Neck Proximal Humerus Fractures: A Biomechanical Comparison

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BACKGROUND: Our study's purpose was to compare the biomechanical properties of a proximal humerus locking plate (PHLP) with a novel antegrade intramedullary nail (IMN) in an osteoporotic two-part surgical neck proximal humerus fracture model. The null hypothesis is that there is no difference in pre- or post-fatigue stiffness between the constructs.

METHODS: Simulated fractures were made in synthetic fourth generation osteoporotic humeri through the surgical neck. One group had a transverse fracture that was instrumented with a PHLP with 7 screws (PHLP-7; n=4), PHLP with 9 screws (PHLP-9; n=2), or an IMN (n=4). Each underwent pre-fatigue testing (AP bending, varus-valgus bending, compression, and torsion), an identical fatigue protocol, followed by post-fatigue testing. A second high oblique fracture line was tested identically with the PHLP-9 (n=4) and IMN (n=4) constructs.

RESULTS: Pre-fatigue stiffness differed in two of four modes of stress. The PHLP-7 was stiffer in anteroposterior bending and torsion (p=0.02 for both) compared to the IMN. No difference was detected between the IMN and PHLP-9 or PHLP-7 and PHLP-9 for these two modes of testing. Analysis did not reveal a difference in stiffness between the three constructs in varus-valgus bending or compression. Post-fatigue stiffness comparisons revealed no difference between three transverse specimen constructs. For the oblique fracture model, pre-fatigue differences were again found in two of four modes of stress with the IMN stiffer in varus-valgus bending and the PHLP-9 stiffer in torsion (p=0.03 for both). Due to specimen failure, we were unable to perform any meaningful post-fatigue analysis.

CONCLUSIONS: The biomechanical performance of a novel short angular-stable proximal humeral nail design was comparable, especially following fatigue, to locked plate/screw constructs in a synthetic osteoporotic two-part surgical neck proximal humerus fracture model.

7. Effects of Joint Contracture on the Contralateral Unoperated Limb in a Rabbit Knee Contracture Model: A Biomechanical and Genetic Study

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PURPOSE: In most animal models, unoperated contralateral limbs are used as controls. However, the contralateral limb may represent a skewed control due to release of systemic factors and altered biomechanics. The main purpose of this study was to determine if the unoperated contralateral limb could be used as a control, or if an unoperated animal's limb should be used instead.

METHODS: Seventeen rabbits were divided into two groups. Group 1 rabbits (n=12) underwent surgery on their right limbs to induce a contracture. Group 2 rabbits (n=5) underwent no surgery. The left non-operated limbs of rabbits in group 1 were biomechanically and genetically compared to the limbs of unoperated rabbits in group 2 with the use of a validated joint measuring device and custom microarray, respectively.

RESULTS: After eight weeks of immobilization, there was a statistically greater flexion contracture in the unoperated contralateral limbs compared to the limbs of animals that received no surgery (8.4 ± 8.9° vs. 0 ± 0°; p-value = 0.03). When animals were remobilized for an additional 16 weeks, the significance was lost (11.9 ± 21.4° vs. 8.9 ± 9.5°; p=0.38). Similarly, there was a statistically significant increase in ten genes at eight weeks ($p<0.001$). However, at 24 weeks, only the PMCA1 gene was statically increased ($p<0.001$).

CONCLUSIONS: In our rabbit model of knee joint contracture, the non-operated limb develops a small flexion contracture which seems to resolve after 16 weeks of remobilization. Likewise, variations in genetic expression appear to resolve after the period of remobilization.

HIP

8. Current National Trends in Total vs. Hemiarthroplasty in the Treatment of Femoral Neck Fractures

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INTRODUCTION: Femoral neck fractures are a common injury that may require arthroplasty acutely. Comparative data examining national trends in the treatment of femoral neck fractures with arthroplasty is lacking. This study aims to characterize and compare national trends in the treatment of these fractures with either total (THA) or hemi-arthroplasty (HA).

METHODS: Patients within the National Hospital Discharge Survey database, which were treated with either a HA or THA for a femoral neck fracture from 1990-2007, were selected for analysis. The age, preoperative health, postoperative complication rate, postoperative disposition, and mortality rate were examined and compared between groups at six-year intervals (1990-1995, 1996-2001, and 2002-2007).

RESULTS: A total of 174,641 fractures were treated with THA, while 1,618,103 were treated with HA. Fewer THAs were performed during each sequential six-year interval, while the converse was true for HAs. The perioperative mortality rates for THA were 1.7%, 2.9%, and 0.8% during these intervals. The corresponding values for HA represented a significant difference and were 3.1%, 2.5%, and 3.0%. Discharge home significantly decreased following THA and HA during each interval. A higher percentage of THA patients suffered an acute dislocation during the first and second six-year intervals; however, this was not observed in the last interval.

CONCLUSION: The number of femoral neck fractures being treated by HA is increasing while the number being treated by THA is decreasing. This may be a reflection of evolving indications that favor one procedure over the other or in response to a higher incidence of dislocation that was seen historically in the THA group. Currently, dislocation rates between these two groups have equilibrated. This may be due to increased utilization of larger femoral head sizes.

9. The Radiographic Findings of Hip Dysplasia are Different in Males Than Females

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INTRODUCTION: Hip dysplasia is more common in females than males. Radiographic evidence of hip dysplasia includes a shallow socket with femoral head uncovering and an anteverted acetabulum with a lateralized hip center of rotation. This study aims to report the radiographic characteristics of dysplastic hips in males prior to PAO and compare these to an aged matched control female cohort.

METHOD: 373 periacetabular osteotomies in 333 patients were performed between January 1996 and May 2009. Radiographic review of the lateral center edge angle (LCE), Tönnis angle, anterior center edge angle (ACE), medial clear space, presence of crossover sign, and presence of cam deformity were assessed prior to undergoing a PAO. Fifty-nine male patients, including first hips in bilaterals, were age matched to two female hips. 111 were matched exactly to the age, and 7 hips were matched within one year of surgery.

RESULTS: The cohort consisted of 59 male hips and 118 female hips. The average male BMI was significantly higher (28 vs. 25.9, p=0.003). The mean LCE angle was significantly worse in males (0 vs. 9.0, p=0.008). Males also had a worse mean Tönnis angle (26.5 versus 21, p=0.0012) and mean ACE angle (0 vs. 7, p=0.02). A statistically significant difference in medial clear space with a more lateralized hip was seen in male hips (17 vs. 11 mm, p=0.001). There was no difference in Tönnis grade (11.5% in males vs. 22.5% in females, p=0.1).

CONCLUSION: Radiographic features of hip dysplasia differ in males when compared to aged matched females. At the time of PAO, male patients have a more severe form of hip dysplasia with a shallower socket, greater femoral uncovering, and a more lateralized center of rotation. The surgeon should be prepared to perform a more aggressive correction in the male hip.

10. The Accuracy of Intraoperative Fluoroscopic Assessment of Periacetabular Osteotomy Correction

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INTRODUCTION: The Bernese Periacetabular Osteotomy (PAO) is an effective treatment for symptomatic acetabular dysplasia. Accurate acetabular correction is fundamental to the clinical success and survivorship of the hip reconstruction. Intraoperative assessment of deformity correction is therefore critical. The purpose of this study is to determine the accuracy of intraoperative fluoroscopic imaging in determining acetabular correction during PAO surgery.

METHODS: Fifty consecutive patients undergoing PAO were included in the study. Fluoroscopic AP and false profile images were obtained after final PAO correction. Standardized fluoroscopic technique was utilized to ensure appropriate pelvic tilt and rotation intraoperatively. Radiographic measurements included the lateral (LCEA) and anterior (ACEA) center edge angles, acetabular inclination (AI), extrusion index (EI), and medial offset distance. The intraoperative deformity correction was compared to correction on postoperative plain AP pelvis and false profile radiographs.

RESULTS: Of all radiographic parameters, LCEA had the highest correlation between intraoperative and postoperative imaging with an intraclass correlation coefficient (ICC) of 0.80 (0.68,0.88). Intraoperative LCEA was within 5° in 88% of cases. Similarly, AI and ACEA also showed substantial reliability with ICCs of 0.76 (0.61, 0.85) and 0.71 (0.54, 0.82), respectively. Intraoperative AI and ACEA were within 5° in 72% and 60% of cases. EI and MO were the least reliable demonstrating moderate reliability with ICCs of 0.66 (0.46-0.79) and 0.46 (0.21, 0.65).

DISCUSSION: Intraoperative fluoroscopic assessment of PAO correction is moderately to substantially reliable for assessing acetabular deformity correction depending on the measurements used. Measurements of lateral center edge angle, acetabular inclination, and anterior center edge angle are most consistent between intraoperative and postoperative assessment.

11. Variation in Contact Areas in the Proximal Femur Depending on Implant Design

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INTRODUCTION: Different uncemented femoral stem designs achieve initial and long-term stability in THA through shape, size, coating, and fit. The desire to optimize load transfer has led to the development of short stems that seek to achieve fixation in the proximal femur. Short stems designed to achieve stability by engaging the metaphysis or the proximal femoral necks are currently in clinical use. The purpose of this study was to examine the extent to which five stems designed to achieve proximal fixation contact the bone in the proximal femur. Using 3D CT models of 30 femurs, we assessed the fit, fill, and contact of each of the five different implants.

METHODS: Using 3D templating software designed to navigate robotic surgery, preoperative CT scans of 30 patients were analyzed. Each of five femoral implant designs was then optimized for size and fit based on manufacturer technique guide and design rationale. The metaphysis was divided into four zones in the axial plane. Five contact points were determined on the frontal plane using anatomical landmarks. Each zone was assessed for cortical contact and fill. We graded contact from 1 to 5.

RESULTS: In the 150 different templates analyzed, significant variability existed in contact areas of the proximal femur depending on implant design and femoral morphology. High femoral neck resection design (ARC) had the greatest contact area in the most proximal zones. The ABG II and Trilock stems had comparable contact in the anteromedial zones, while the ABG II had greater fill in the sagittal plane. The Trilock was the only stem that consistently achieved lateral cortical contact at the distal landmarks.

DISCUSSION: To our knowledge, this is the first study to examine the contact points of metaphyseal engaging stems in the proximal femur. By directly comparing implant contact points in the same femur, we found significant variability in the extent of fit, fill, and contact of the metaphysis. These differences in proximal femoral contact are likely to have implications for fixation in bone of varying quality and for long-term proximal bone remodeling.

12. Is Coxa Profunda a Useful Radiographic Feature of Pincer-Type Femoroacetabular Impingement?

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INTRODUCTION: Coxa profunda is commonly viewed as a radiographic finding consistent with pincer-type femoroacetabular impingement (FAI). The combined (cam/pincer) form of FAI occurs most commonly. Validation of coxa profunda as a measure of pincer-type FAI is limited. Our hypothesis is that coxa profunda is a very common radiographic finding in females and is not an accurate parameter for diagnosing pincer-type FAI.

METHODS: The presence or absence of coxa profunda was analyzed in five groups: dysplastic hips (n=59), symptomatic FAI hips (n=50), Perthes hips (n=16), and asymptomatic hips (n=33). Coxa profunda was defined as present when the floor of the acetabular fossa touches or is medial to the ilioischial line. The correlation between coxa profunda and gender was also analyzed.

RESULTS: Coxa profunda was present in 54.4% (86/158) of all hips, and was least common in the dysplastic and Perthes hips (40.7% [24/59] and 31.3% [5/16], respectively). Coxa profunda was present in 75.8% (25/33) of asymptomatic hips, compared to 64.0% (32/50) of FAI hips. Coxa profunda was more common in females (69.8%, 74/106) than males (23.1%, 12/52) ($p<0.001$), and was present in 87.5% of asymptomatic females and 44.4% of asymptomatic males. Coxa profunda was present in 77.8% of females with FAI and 28.6% of males with FAI.

DISCUSSION: Coxa profunda does not appear to be a useful or specific parameter in the evaluation for pincer-type FAI. Coxa profunda is highly correlated with female sex, and is not uncommon even in the dysplastic hip. Alternative parameters of pincer-type FAI should be utilized for diagnostic and surgical planning purposes.

13. Higher Complication Rate in Obese Than Non-Obese Patients After Periacetabular Osteotomy

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Periacetabular osteotomy (PAO) has gained popularity for the treatment of the young adult with symptomatic hip dysplasia. Obese patients are at higher risk of postoperative complications after total hip arthroplasty, but there has been no report on the prevalence of complications in patients who are obese and have undergone a PAO. We, therefore, asked whether obesity defined as body-mass-index (BMI) greater than 30 was a risk factor for the development of postoperative complications in patients undergoing a PAO. In this study, we included patients who underwent a PAO who had a minimum of one-year follow-up. Patients were divided into two groups based on their BMI: non-obese (BMI ≤ 30) and obese (BMI >30). The occurrence of complications was recorded using a modification of the Clavien-Dindo complication scheme for hip preservation surgery. In this system, complications are graded from 1 to 5 in severity, with each grade based off the long-term morbidity of the complication and the treatment necessary to manage the complication. A regression analysis was performed to assess the risk of complications in obese patients. A total of 190 patients were included in this study. There were 39 (20.5%) males and 151 (79.%) females with a mean age of 31 (range, 12-53) with a mean follow-up of 3.75 years (range, 1-14 years). There were 61 hips in the obese group and 129 in the non-obese group. The age and gender distribution was similar between the two groups. There was a statistical significant higher risk of developing one complication in the obese group (OR 3.9; CI 0.13-0.52). In addition, for each grade of complication there was a higher risk in obese patients when compared to non-obese patients. There was a statistically significant increase in complications after PAO in patients whose BMI was greater than 30. Obesity was found to be an important risk factor that increased all grades of complications as defined by the Clavien-Dindo classification following a PAO. The hip preservation surgeon must recognize the increased risk of complications associated with obesity and educate patients accordingly and in select cases recommend weight loss before proceeding with PAO.

14. Surgical Hip Dislocation for the Treatment of Femoroacetabular Impingement in Patients 40 and Older

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INTRODUCTION: Both open and arthroscopic joint preserving procedures are an accepted treatment option femoroacetabular impingement (FAI). The fifth decade of life has been described as a relative contraindication to surgical hip dislocation (SHD). We report on a select group of patients with a minimum age of 40 who underwent (SHD) for the treatment of FAI.

METHODS: Twenty-one patients (22 hips) with a minimum age of 40 who had undergone SHD were identified from 155 patients (178 hips) treated with SHD between August 2002 and February 2011. Seven women and 14 men with an average age of 44 years (40-50) were identified. Clinical notes, radiographs, and operative notes were reviewed.

RESULTS: One patient was lost to follow-up. Average follow-up was 17 months (2-45). At the time of SHD, 17/22 had chondral damage and 21/22 had labral pathology. Twelve had labral debridements, 4 had repairs, 3 had the labrum taken down and re-fixed as part of a rim trimming, and 2 underwent labral reconstruction. All 22 underwent an osteochondroplasty of the head/neck junction. There were no perioperative complications. At follow-up, 15/21 (71%) had pain relief while 6/21 (29%) continued with some pain. Four (19%) underwent subsequent total hip arthroplasty (THA) for progressive symptoms. The average time between SHD and THA was 2.6 years (0.9-6.2).

CONCLUSION: SHD can be used for the treatment of FAI in patients without radiographic evidence of end-stage arthritis who are 40 and older, but the strict selection criteria must be met as the prevalence of articular cartilage damage and labral pathology was high. The procedure has a low morbidity, but less invasive procedures should be performed if they can be performed with the same precision. SHD should continue to be used as an option in patients older than 40 with preserved joint space and with more severe structural abnormalities.

15. Acetabular Cup Positioning: You're Not Where You Think You Are

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INTRODUCTION: Component positioning during total hip arthroplasty (THA) is of extreme importance for issues of dislocation and wear rates. The emergence of computer navigation-assisted surgery has provided an opportunity for more consistent implant placement. The objectives of this study were to (1) compare acetabular component positioning with and without computer navigation and (2) identify the ability to place the acetabular component in the same position without navigation as previously reamed using navigation.

METHODS: The study design was a review of prospectively collected data with retrospective comparison to a previous cohort. The study group included all patients undergoing primary THA by a single surgeon with and without computer navigation using the transverse acetabular ligament (TAL) as a landmark. Additionally, for the computer navigation group, the cup was initially positioned in the area the surgeon felt was equivalent to the area reamed. The difference between this position (without navigation) and the computer-navigated position was recorded.

RESULTS: Prior to the use of computer navigation, the average acetabular component placed in the accepted safe zone was 61% (175 of 287). Following implementation of navigation, the average acetabular component placed within the safe zone was 93% (296 of 318). Attempts at positioning the acetabular component within 5° of the position previously reamed were successful 57% of the time with an average deviation of 11°.

CONCLUSION: The inclusion of computer navigation using the TAL as a landmark led to improved, more consistent positioning of the acetabular component. Furthermore, surgeons are not necessarily in the position they think they are when placing final components, and confirmation with navigation can provide superior results.

16. Novel Preoperative Planning Coupled with Patient Specific Instrumentation Improves Acetabular Implant Placement

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INTRODUCTION: Preoperative assessment of acetabular pathology, planning of bone preparation, and implant placement using current imaging and templating techniques are imprecise. Reliance on standard instruments that do not take into consideration a patient's unique anatomy or degree of pathology impedes the successful execution of a preoperative plan. Consequently, components are often malpositioned, potentially leading to premature failure requiring revision arthroplasty. We hypothesized that a novel three-dimensional (3D) preoperative planning software coupled with unique patient and implant specific instruments (PSI) generated from the preoperative plan will improve the accuracy of acetabular component placement compared with standard planning and instrumentation.

METHODS: This study tested and compared the accuracy of surgeons in achieving the planned location for acetabular components using two approaches: (1) standard preoperative imaging and instrumentation, and (2) a novel 3D computed tomography (CT) scan based software linked to patient and implant specific instrumentation. Seven surgeons placed acetabular components in identical pathologic sawbones hemipelvi twice using both protocols. Differences between the postoperative implant location and the preoperatively planned location were compared.

RESULTS: Compared to standard techniques, the use of 3D CT planning and PSIs resulted in a significant improvement in the average deviation of implant position (actual versus planned) for version ($p=0.0149$), inclination ($p=0.0013$), and total offset ($p<0.0001$).

CONCLUSION: Variation in component placement among and within surgeons was markedly reduced with the use of PSI technology. The use of this novel preoperative planning software combined with PSI technology improves the accuracy with which a surgeon is able to place an acetabular cup relative to the preoperatively planned orientation. Used during primary hip arthroplasty, this technology may improve initial implant placement, which may lead to a decrease in the incidence of failure and improve function.

17. Relationship Between Femoral and Acetabular Alignment in Normal Hip Joints: A Three-Dimensional Analysis

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INTRODUCTION: The bony architecture of the hip depends upon functional adaptation to mechanical usage. Radiographic evidence of acetabular retroversion alone is thought to warrant a diagnosis of pincer-type femoroacetabular impingement (FAI). However, studies of pathologic hip joints suggest proximal femoral anatomy compensates for acetabular anatomy. This study tested for correlations among proximal femoral and acetabular angles, age, and gender in normal hips.

METHODS: Computed tomography (CT) scans depicting the pelvis and lower extremities of 143 anonymized subjects were obtained from a database of vascular CT angiography scans taken between November 2007 and March 2010. Twenty-eight scans were excluded due to radiographic evidence of osteoarthritis. A chart review was performed to assure the remaining 115 subjects did not have symptoms of hip pathology. Scans were loaded into an in-house, proprietary software package to create three-dimensional volumetric images. The femoral neck version, femoral neck shaft angle, acetabular version, acetabular inclination, and acetabular center edge angle were measured. Correlations between the angles, age, and gender were examined using stepwise regression (SAS, Cary, NC).

RESULTS: Positive correlations were found between femoral version and acetabular version ($p=0.0014$), femoral neck shaft angle and acetabular version ($p=0.0134$), acetabular version and gender ($p=0.018$), and center edge angle and gender ($p=0.018$). Negative correlations were observed between femoral neck shaft angle and age ($p=0.0003$), and femoral version and acetabular inclination ($p=0.0026$), although this latter relationship was only observed unilaterally (i.e., left hip).

DISCUSSION: Correlations between multiple proximal femoral and acetabular angles support the hypothesis that a complementary developmental relationship occurs between the femoral head and acetabulum. Future investigation into the relationship between these angles in patients with the signs and symptoms of pincer-type FAI may alter a surgeon's approach to treating this patient population.

18. Descriptive Epidemiology of Femoroacetabular Impingement: A North American Cohort

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(Presented by Jeffrey J. Nepple, M.D., St. Louis MO)

INTRODUCTION: Symptomatic femoroacetabular impingement (FAI) is associated with hip pain, functional limitations, and secondary osteoarthritis. There is limited information from large patient cohorts defining the specific population affected by FAI. Establishing a large cohort will facilitate identification of “at risk” patients, and will provide a population for ongoing clinical research initiatives. Therefore, we have established a multicenter, prospective, longitudinal cohort of patients undergoing surgery for symptomatic FAI. The purpose of this study is to report the clinical epidemiology and contemporary surgical treatment trends for patients with symptomatic FAI.

METHODS: Upon approval of the Institutional Review Boards at seven institutions, nine surgeons enrolled patients undergoing surgical intervention for symptomatic FAI from 2008-2011. Patient demographics, physical examination, radiographic data, diagnoses, operative data, and standardized patient reported outcome measures are collected. The first 845 cases are analyzed in this study.

RESULTS: 790 consecutive patients (845 hips) are enrolled. Sixty percent are female, 40% male, the average age is 26.2 years, and the average BMI is 25.0. Patients of the Caucasian race (91%) are predominantly treated for FAI. Nineteen percent reported a family history of hip surgery. Three percent reported disability due to hip pain at time of surgery. Forty percent of hips had a diagnosis of CAM FAI, 5% Pincer FAI, 53% Combined FAI, and 2% AIIS impingement. The primary surgical interventions were arthroscopy (51%), surgical dislocation (28%), limited open (18%), and reverse PAO (3%). Eighty-two percent of cases included a femoral head neck osteochondroplasty and 36% an acetabular rim osteoplasty. Forty-four percent had a labral repair, 16% labral debridement, and 39% acetabular chondroplasty.

CONCLUSION: This multicenter, prospective, longitudinal cohort is one of the largest FAI cohorts to date. These data indicate that FAI occurs predominantly in young, Caucasian patients with normal BMI, and there is a higher rate of occurrence in women. A combined (CAM/pincer) FAI disease pattern is most common. Contemporary treatment is predominantly arthroscopic followed by surgical hip dislocation.

19. Intra-Articular Abnormalities Associated with Residual Perthes-Like Hip Deformities

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BACKGROUND: Residual Perthes-like hip deformities are complex and may encompass proximal femoral deformity, secondary acetabular dysplasia, and associated intra-articular abnormalities (labral tears, articular cartilage, and osteochondral lesions). These intra-articular abnormalities have not been well characterized.

QUESTIONS/PURPOSES: The purpose of this study was to determine the characteristics of intra-articular disease associated with residual Perthes-like hip deformities.

METHODS: Thirty-five patients (36 hips) with residual Perthes deformities and hip symptoms were treated with surgical dislocation (24 males, 11 females; mean age, 18.5 years). Intraoperative findings were documented prospectively and comprehensive radiographic review performed. Radiographic findings were correlated with intraoperative findings.

RESULTS: Labral tears and acetabular cartilage lesions were present in 72% and 56% of hips, respectively, and were primarily located at the anterior (96%; 65%) and superolateral (62%; 80%) labrochondral junctions. Femoral head chondromalacia was observed in 81% of hips. Male sex was associated with severe chondromalacia (64% vs. 27%), femoral head chondromalacia (35% vs. 18%), and advanced radiographic arthritis (44% vs. 9%) (all $p \leq 0.043$). Stulberg classification of 3 or greater was associated with moderate to severe acetabular chondromalacia (71% vs. 30%; p 0.017). LCEA < 20° was protective of severe chondromalacia (38% vs. 73%; p 0.037) and radiographic arthritis (19% vs. 53%; p 0.031). This protective effect was also noted with acetabular inclination > 15° for any severe chondromalacia (23% vs. 70%; p 0.007). Center-trochanteric distance < 1.7 was associated with more labral tears (90% vs. 57%; p 0.042).

CONCLUSIONS: Chondral lesions of the acetabulum and femoral head, in additional to labral disease, are common in symptomatic residual Perthes deformities. These factors should be considered in preoperative surgical planning and when counseling patients regarding surgical outcomes.

20. A Mid-Term Comparison of Off-the-Shelf and Custom Short Stem Metaphyseal Femoral Implants

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INTRODUCTION: Short-stem metaphyseal engaging femoral implants provide theoretical benefits compared to uncemented stems of conventional length. These include: (1) avoidance of proximal-distal mismatch, (2) decreased proximal stress shielding, and (3) reduction in perioperative periprosthetic fractures. This study compares the minimum four-year clinical and radiographic results obtained with an off-the-shelf metaphyseal filling short stem to the five-year follow-up data obtained with a custom-made short stem implant.

METHODS: A prospective evaluation of 51 hips in 50 patients treated with an uncemented metaphyseal engaging short (91-105 mm) stem with minimum 48 month follow-up was performed. The average age of patients in the study group at follow-up was 71 years (range: 32-95) with an average BMI of 28 (range: 19-42). The control group consisted of 69 THAs with CT-based custom-made short stem implants. These patients averaged 61 years of age (range: 22-79) and BMI of 28.9 (range: 20.3-44.1) at follow-up.

RESULTS: In the off-the-shelf short stem group, the average Harris hip score (HHS) was 51 (range: 10-70) preoperatively and 91 (range: 70-100) postoperatively; preoperative WOMAC scores averaged 49 (range: 9-91), compared to a postoperative average of 6 (range: 0-25). No patients had thigh pain. All stems were radiographically stable with proximal bony in-growth. In the control group with custom short stems, the HHS averaged 55 (range: 20-90) preoperatively and 96 (range: 55-100) postoperatively; WOMAC scores average 51 (range: 13-80) preoperatively and 3 (0–35) postoperatively. There was no difference in postoperative pain or function scores between the two groups (two-sample t (179 df)=0.667, p=0.506).

DISCUSSION AND CONCLUSION: This study confirms that an off-the-shelf short femoral stem designed to fit and fill the metaphysis provides as reliable fixation and function at a minimum four-year follow-up as a short stem custom implant designed to maximize metaphyseal contact.

KNEE

21. Revision of the Multiply Operated Knee Using the RHK Mobile Bearing Revision TKA Device

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INTRODUCTION: We report the mid-term results of one rotating hinged knee device (RHK™ - Zimmer) used to address the complexities of bone and soft tissue loss in revision of the failed revision TKA.

METHODS: Twenty-six patients were treated between 2004 and 2010. The main indications for revision were loosening, instability, and infection. This revision surgery was performed as the (average) fourth operation (range 2-7). Modular components, including stems, buildups, and trabecular metal augments were used frequently.

RESULTS: At most recent follow-up, Knee Society Scores had improved from 32 to 66 and Knee Function Scores had improved from 26 to 32. Range of Motion improved to an average of 102°. Although all implants remain in place without evidence of loosening at the time of this report, there was a high reoperation rate (34.6%), related primarily to extensor mechanism disruption (19%) or hematoma, with and without infection (12%).

CONCLUSION: In cases of multiply revised difficult knee revisions, the use of the RHK device can result in a predictable lasting improvement. However, the surgeon should be prepared to address other soft tissue problems, such as extensor mechanism compromise and postoperative hematoma (with or without infection) that occur commonly in these complex cases.

22. Factors Influencing the Outcome of Autologous Chondrocyte Implantation: A Systematic Review

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BACKGROUND: Autologous chondrocyte implantation (ACI) is becoming an increasingly effective method of treatment of osteochondral lesions in the knee. The outcomes of ACI surgery have been studied, and qualitative systematic reviews discussing factors affecting the outcome of ACI have been conducted. Patient-specific and lesion-related factors have been linked with ACI treatment outcomes. However, this systematic review based evidence lack the statistical power of a quantitative analysis. The purpose of this review is to (1) compile subject-level data from current studies on ACI in the literature and (2) quantitatively analyze this data set for possible associations between patient-specific and lesion-related factors and the outcome of ACI surgery.

METHODS: A systematic search was done on the Pubmed, Medline, CINAHL, SportDiscus, and Cochrane databases for studies investigating ACI treatment outcomes. Inclusion criteria were clinical studies in English, done on human subjects, that focused on ACI treatment of osteochondral defects. Only studies that published subject-level data were included. Data on patient and lesion characteristics as well as clinical outcome scores was collected from each study on its subjects, and the created dataset was analyzed for associations between the outcomes and the subject variables.

RESULTS: Fourteen studies examining 317 osteochondral lesion cases were included in this review. There was missing data in all of our variables, especially for clinical outcome scores. Patient age, gender, BMI, duration of symptoms, and lesion size, location and compartment laterality were independently tested and found insignificantly associated with clinical outcomes: IKDC, ICRS, and VAS ($P>0.05$ for all). Age and duration of symptoms were the only two covariates that were associated (rho: 0.237, $P=0.006$). As age increased, duration of symptoms increased as well.

CONCLUSIONS: ACI surgery has been shown to yield satisfactory outcomes in patients with chondral lesions. Despite evidence in the literature showing that multiple patient and lesion factors may influence treatment outcomes, our review shows that these factors, solely, do not affect outcomes. However, together, they may synergistically affect outcomes, since they may be linked to one another. Multivariate analyses with larger samples should be conducted.

23. Weightbearing, Three-Dimensional Alignment of the Normal Adult Knee

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INTRODUCTION: The ideal alignment target for total knee arthroplasty is a topic of debate with alignment of the mechanical axis through the center of the knee as a frequently stated goal. A study was undertaken to determine the three dimensional weight-bearing knee alignment in a normal adult population.

METHODS: Weight-bearing, biplanar imaging of normal healthy adults was undertaken with a low dose highly collimated imaging technology that allows correction for rotation and accurate digital processing of mechanical axis and standard coronal alignment measurements. One hundred normal volunteers (200 knees), average age 39 (range 21-72), 76% female, with no history of trauma, surgery, symptoms, or treatment of the spine or lower extremity underwent imaging of both lower extremities. Measurements included the femorotibial angle (FTA between the neutral axis of the distal femur and tibia, target 2° to 8° valgus), the hip-knee-ankle angle (HKA, the angle between the center of the femoral head to the center of the knee and center of the knee to center of the ankle, target 0° ± 3°), and the zone of the mechanical axis (the percentage of time that the mechanical axis from the center of the hip to the center of the ankle passes through the central one-fifth of the tibia).

RESULTS: In this normal, asymptomatic group of 200 knees corrected for rotation when weight-bearing, 32% were outside the 2° to 8° range for femorotibial angle, 24% were outside the 0° ± 3° range for hip knee ankle angle, and 38% had a mechanical axis that passed outside of the central fifth of the knee joint.

CONCLUSION: Approximately one-third of normal healthy adults have knee alignment outside of the generally accepted targets for optimal total knee alignment. Placing all total knee patients within the defined mechanical axis targets substantially changes the limb alignment of many patients.

SPINE

24. Analysis of Vertebral Bone Mineral Density of Computed Tomography

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INTRODUCTION: Vertebral fractures are estimated to occur once every 22 seconds. They are a significant source of morbidity and health care expenditure, which will continue to increase as our population ages. Along with increased age, low bone mineral density is known to be a significant risk factor contributing to vertebral fractures. However, few studies have investigated whether there is variance in bone mineral density across vertebral levels and with respect to sex and age.

METHODS: We identified 2,622 trauma patients between 2002-2010 who underwent a CT scan encompassing any part of their thoracic or lumbar spine. All CT scans were processed using semi-automatic algorithms through MATLAB R2011a. The mean Hounsfield Unit (quantitative scale for describing radiodensity) within each vertebral body was ascertained, which served as our measure of bone mineral density. This was performed at each vertebral level present on a given CT scan. Mean bone mineral density values were subsequently analyzed with respect to vertebral level, sex, and age.

RESULTS: Analysis of CT scans yielded 26,346 unique vertebrae (17,067 male, 9,279 female) for which bone mineral density measurements were obtained. Across both sexes, there was a downward trend in bone mineral density with age. Across both sexes and nearly all age ranges, the lowest mean bone mineral density among thoracic vertebrae was at T8 and among lumbar vertebrae it was at L3. These were significantly lower when compared to the mean bone mineral density of the cumulative vertebrae for any corresponding age range ($p<0.05$).

CONCLUSIONS: With this work, we present a large scale analysis of vertebral bone mineral density values across a diverse population. Our findings not only reaffirm declining bone mineral densities with age, but also suggest specific vertebral levels at higher risk for fractures. These data may help further identify patients at risk for fractures, and, as a result, may help inform clinical decision making and targeted therapeutic interventions.

25. Prevalence and Functional Outcomes of Spinal Cord Injury Syndromes in Adult Patients with Traumatic Brachial Plexus Injuries

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INTRODUCTION: The high-energy mechanism of injury required to cause a traumatic brachial plexus injury can also result in a concomitant spinal cord injury syndrome. We hypothesize that there will be a low prevalence of spinal cord injury syndromes in the brachial plexus injured patient with poor functional results after brachial plexus reconstruction.

METHODS: We performed a retrospective review of adult patients with a traumatic brachial plexus injury evaluated at a tertiary, multi-disciplinary brachial plexus clinic from January 2000 to December 2008. Patients with clinical findings for a spinal cord injury syndrome were identified. Clinical results and/or operative intervention were evaluated.

RESULTS: A total of 255 patients were evaluated for a traumatic, traction injury to the brachial plexus. There were four cases of Brown-Sequard syndrome (1.6%, 4/255) and two cases of anterior cord syndrome (0.78%, 2/255). All patients had sustained a preganglionic brachial plexus, with or without a combined postganglionic injury. One patient with a Brown-Sequard syndrome was treated nonoperatively. Otherwise, the remaining patients underwent an operative procedure to the brachial plexus injured upper extremity. All patients had a very suboptimal functional outcomes after brachial plexus reconstruction.

CONCLUSION: Combined brachial plexus injury and spinal cord injury syndromes are rare and high vigilance should be maintained for identifiable spinal cord injury syndromes in the traumatic brachial plexus injured patient. Upper motor neuron lesions associated with spinal cord injury syndromes may affect the outcomes of brachial plexus reconstruction.

TRAUMA

26. Outcomes and Complications After Bilateral Tibia Fractures: How Bad Are They?

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INTRODUCTION: Bilateral tibia shaft fractures are thought to represent significant, high-energy injuries. The purpose of our study was to compare the associated injuries and outcomes of patients with bilateral (BTF) and unilateral (UTF) tibial shaft fractures.

METHODS: The records were reviewed to identify patients treated over a five-year period (2004-2009). Data was gathered on demographics, injury severity measures, treatment type, complications, and functional outcomes. A unilateral fracture cohort with similar demographics, injury and fracture details was selected from a randomized list. Differences in associated injuries, complications, and outcomes were analyzed.

RESULTS: There were 35 BTF patients and 34 UTF matched patients. The average ISS was 21 in BTF/18 in the UTF. There were significant differences ($P<0.05$) found in open fractures (83% BTF/56% UTF), need for mechanical ventilation (69% vs. 41%), and need for additional surgeries to promote healing (60% vs. 27%). There were five mortalities in the BTF and three in the UTF group. In the BTF group, three patients (four limbs) required primary amputation. There were no amputations in the UTF group. There was no significant difference in the rate of nonunions ($p=0.318$) or occurrence of compartment syndrome ($p=0.088$). Functional outcomes were similar with 19 BTF patients (54%) and 19 UTF patients (56%) returning to independent ambulation, 9 (26%) BTF patients and 9 (27%) UTF patients using assistive devices. The average follow-up was 16.2 months for BTF group and 14.7 months in the UTF group.

CONCLUSION: BTF are a rare occurrence and frequently linked to high-energy mechanisms and multiple trauma. We found, though more BTF patients required mechanical ventilation, there was no significant difference in ISS, associated injuries, and other trauma severity indicators. The higher rates of open fractures and need for revision surgery may be additive in the bilateral group. When injury factors are controlled, patients with bilateral tibial shaft fractures have similar functional outcomes to unilateral patients.

27. Factors Influencing the Effectiveness of Blood Salvage in Acetabular Fracture Surgery

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BACKGROUND: Fixation of acetabular fractures via an anterior surgical approach is associated with large amounts of surgical blood loss. Blood conservation techniques are often utilized to limit the amount of blood transfusions required. In this study, we sought to identify factors that can lead to the effective utilization of blood salvage in the operating room.

METHODS: We performed a retrospective review of 129 operative procedures that occurred via an anterior surgical approach for an acetabular fracture between 2001 and 2010. Variables tested were sex, age, Letournel fracture pattern, surgical approach, preoperative hemoglobin level, preoperative red blood cell transfusion, prior surgical intervention, Injury Severity Score (ISS), and interval between injury and surgery. Results were categorized into (1) cell salvage was not present during surgery, (2) cell salvage was available, but no blood was returned to the patient, (3) less than 750 mL of autologous blood transfusion via cell salvage, and (4) greater than 750 mL of autologous blood transfusion via cell salvage. Cost effectiveness and autologous transfusion effect on perioperative allogeneic transfusions were evaluated as well.

RESULTS: Of the 129 procedures, cell salvage was utilized 119 times. 40/119 times there was not enough blood collected to be returned to the patient. A both column acetabular fracture demonstrated increased utilization of cell salvage and autologous transfusion (35/47 vs. 34/62, p=0.045) as well as increased cost effective usage of cell salvage over other fracture patterns (12/47 vs. 2/62, p=0.026). Male sex was also associated with increased autologous transfusion (54/78 vs. 15/31, p=0.0496). There was no association in the other variables tested and cell saver utilization. Furthermore, autologous blood transfusions did not affect the rate of allogeneic blood transfusions during the perioperative period (24/60 vs. 36/69, p=0.216).

CONCLUSIONS: Both column acetabular fractures are more likely to result in increased autologous blood return, as well with enough volume that it may be cost effective; however, cell salvage overall does not appear to decrease allogeneic blood transfusion requirements.

28. Clinical Outcome After Lumbopelvic Fixation for Pelvic Fractures

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PURPOSE: Dysmorphic upper sacral segments, sacral U fractures, osseous compression of neural elements, and failed fixation of sacral fractures pose problems for traditional sacral fixation techniques. Lumbopelvic fixation allows for reduction, stabilization, and potentially early weight bearing. The purpose of this study was to evaluate the clinical results, radiographic accuracy of reduction, complications, and functional outcomes of lumbopelvic fixation of complex sacral fracture patterns.

METHODS: Over a five-year period, 15 consecutive unstable sacral fractures (46.7% males) were treated with lumbopelvic fixation in a single level 1 trauma center and followed for a minimum of one year. Age was 39 years. BMI was 28 kg/m². All patients underwent clinical examination, radiographic imaging, and completed the Short Musculoskeletal Function Assessment (SMFA) at a minimum of one year.

RESULTS: The posterior zone injury pattern according to Denis was 4 zone 2, 3 zone 3, and 8 bilateral zone 3 injuries. Using the Roy-Camille classification, the subgroups were 2 type I, 2 type II, 2 type III, and 2 type IV. Forty percent had additional spine injuries. Neurological complications occurred in 5/6 spine injuries (χ^2=0.02) and related to 24-month bother score (p=0.008). Based on Matta, reduction quality was excellent in 73% and good in 27%. Posterior reduction quality did not relate to outcome (p>0.05). One patient had loss of fixation and developed a nonunion. Four patients had prominent hardware and significant greater pain at 12 months (p=0.02), but only 2/4 had hardware removal. Seventy-three percent (11) of all patients were able to return to their previous work.

CONCLUSION: Lumbopelvic fixation is an extensive procedure with numerous potential complications, but high success rates can be achieved when it is performed systematically and in appropriately selected patients. Prominence of iliac screw heads is a frequent problem and leads to significant pain. Lumbopelvic fixation seems to be the superior fixation for lumbosacral dissociation and unstable sacral fractures and allows return to work even after complex sacral fractures.

29. Rib Fracture Fixation: Initial Experiences and Outcomes

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SUMMARY: Initial experience and utilization of rib fixation techniques for treatment of flail chest appears to be safe and carry significant patient benefits with minimal initial learning curve.

METHODS: Twelve consecutive patients who underwent operative reduction and fixation of flail chest at a Level 1 trauma center were reviewed at six months postoperatively. The short McGill Pain Questionnaire was administered to the patients at this time to assess patient-reported functional outcomes.

RESULTS: Our patient group had an average age of 52.9 years (range 18-90), with all injuries being caused by motor vehicle collisions or falls. The patients were operatively treated at a mean of 6.9 days after injury, with a mean of 4.7 ribs fixed in each patient. Postoperatively, the patients remained in an intensive care setting for a mean of 5.4 days and required a chest tube for 6.8 days. Two patients required a tracheostomy, while five patients were discharged directly to home. Total operative time and operative time per rib and per fracture decreased throughout the study period. At final follow-up, no incisional or soft tissue complications were noted; all fractures went on to clinical and radiographic union, with restoration of thoracic shape and symmetry. In addition, the patients showed evidence of excellent thoracic pain relief at this time, with mean short McGill Pain Questionnaire scores of 3.4.

CONCLUSION: Initial experiences with rib fixation for treatment of flail chest appear to be safe when utilized in the trauma population. Although further investigation is warranted regarding optimal fracture fixation constructs, timing of surgery, and indications, this procedure appears to have significant potential benefits over conservative treatment of this devastating injury.

UPPER EXTREMITY

30. Inflammatory Blood Levels as Markers for Purulent Flexor Tenosynovitis

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HYPOTHESIS: In addition to clinical signs, inflammatory markers are currently used to help in the diagnosis of purulent flexor tenosynovitis. The purpose of this study is to calculate diagnostic accuracy of inflammatory markers such as WBC, ESR, and CRP for purulent flexor tenosynovitis.

METHODS: Seventy-one consecutive patients from 2003-2011 at two academic centers with operative findings of confirmed purulent flexor tenosynovitis underwent retrospective analysis for preoperative WBC, ESR, and CRP to determine sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV).

RESULTS: In our study group, WBC has a sensitivity of 39%, specificity of 100%, PPV of 100%, and NPV of 4.5%. ESR has a sensitivity of 41%, specificity of 100%, PPV of 100%, and NPV of 3%. CRP has a sensitivity of 76%, specificity of 100%, PPV of 100%, and NPV of 13%. Forty-six of the 71 patients were culture-positive (65%). Thirty-eight percent were culture-positive for methicillin-sensitive *Staphylococcus aureus* (MSSA), 13% were positive for methicillin-resistive *Staphylococcus aureus* (MRSA), and 20% were positive for *Streptococcus*.

CONCLUSION: WBC and ESR have poor sensitivity for detecting purulent flexor tenosynovitis while CRP has a sensitivity of 76%.

31. Feasibility of Contralateral Trapezius Transfer to Restore Shoulder External Rotation: Part I

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PURPOSE: Loss of shoulder function, specifically external rotation, is very disabling in patients with brachial plexus injury. The purpose of this study is to evaluate the feasibility of contralateral trapezius transfer to restore shoulder external rotation.

METHODS: The length of the lower trapezius and the distance necessary for contralateral trapezius transfer were measured on the surface in 20 volunteers and directly in 12 cadavers. The average length of lower trapezius, and the distance for transfer were measured with the scapula at neutral, maximally protracted, and maximally retracted. In cadavers, the origin of the left lower trapezius was transferred to the contralateral shoulder, then pulled on to determine the effectiveness in externally rotating the right shoulder and tension on the vascular pedicle.

RESULTS: In the volunteers, the average difference between the length of the lower trapezius and the distance necessary for the transfer was 19 mm $\pm$ 7 mm in neutral. The mean difference in the protracted scapula was 79 mm $\pm$ 6 mm, and when retracted was -49 mm $\pm$ 8 mm. In the cadavers, the average distance between the spine and the greater tuberosity was 290 $\pm$ 12, 365 $\pm$ 15, and 209 $\pm$ 25 in neutral, protracted, and retracted positions. The average length of the lower trapezius was 270 $\pm$ 10, 285 $\pm$ 12, and 258 $\pm$ 10 in the neutral, protracted, and retracted positions without lumbar fascia prolongation. Transfer of the contralateral trapezius was feasible in all specimens when the scapula is partially retracted. When the detached lower trapezius is prolonged with lumbar fascia, the transfer was possible in all positions of the scapula without tension or impingement on the neurovascular pedicle. The transferred muscle was effective in externally rotating the shoulder.

CONCLUSION: Based on this study, contralateral trapezius transfer to the infraspinatus appears to be feasible and potentially effective in restoring external rotation.

32. A Biomechanical Comparison of Three Methods to Repair Pectoralis Major Ruptures

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BACKGROUND: The anatomy of the pectoralis major tendon is unique with an elongated thin footprint requiring multiple points of fixation to restore the native anatomy. The intent of this study was to compare the load to failure of bone trough, cortical button, and suture anchor repairs of the pectoralis major tendon in the extended and abducted position.

METHODS: Thirty fresh frozen cadaveric shoulders were divided equally into three groups based on the repair technique. Bone mineral density of the surgical neck of the proximal humerus was assessed prior to repair in order to assess the influence of osseous integrity on each technique. Bone trough, suture anchor, and cortical button repairs were performed in a randomized manner. Finally, load to failure was performed on each specimen while observing the mode with which failure occurred.

RESULTS: The majority of failures occurred through the No. 2 fiberwire suture utilized for tendon repair. One specimen in the bone trough group failed via fracture of the proximal humerus. The suture anchor group failed evenly at the implant (5/9) and through the suture (4/9). Load to failure was greatest in bone trough repairs at 596 N, followed by cortical button at 494 N, and finally suture anchor repairs with 383 N. Load to failure was significantly increased in the bone trough group when compared to suture anchor repairs ($p = 0.007$). Bone mineral density showed no statistical significance.

CONCLUSIONS: In this study, a superior load to failure was demonstrated when performing pectoralis major tendon repairs using a bone trough method over suture anchors for repair. The increased load to failure in the bone trough group may be due to a larger area of force transmission when compared to the cortical button and suture anchor repairs.

33. Neck-Shoulder Crossover: How Often Do Neck and Shoulder Pathology Masquerade as the Other?

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SUMMARY: Consecutive new patients seen at orthopedic spine and shoulder clinics were reviewed. Five percent of shoulder patients and 6.5% of spine patients had significant pathology involving the other.

INTRODUCTION: Identification of the correct pain generator is a pre-requisite for providing effective treatment in patients with neck and/or shoulder problems. However, distinguishing between the two could be difficult. The relative frequencies of how often one is mistaken for the other has not yet been well established.

METHODS: 694 new patients were seen at the orthopedic shoulder clinic (n=454) and spine clinic (n=240) at an academic institution during a two-year period. 109 patients had previous shoulder surgery, and 36 had previous neck surgery. The 549 patients (shoulder clinic = 348; spine clinic = 201) who had no previous surgery were reviewed for workup performed, final diagnosis, subsequent operative procedures, and incidence of referral from the shoulder to the spine clinic and vice-versa.

RESULTS: Among patients seen at the shoulder clinic, 323 (92.8%) were found to, indeed, have shoulder pathology, 9 (2.6%) had neck and not shoulder pathology, 8 (2.3%) had both shoulder and neck pathology, and 8 (2.3%) had an unidentifiable cause of pain. Among the 17 patients who had neck pathology, only 1 (0.3%) underwent neck surgery.

Among patients seen at the spine clinic, 175 (87.1%) were found to, indeed, have neck pathology, 9 (4.5%) had shoulder and not neck pathology, 4 (2.0%) had both neck and shoulder pathology, and 13 (6.5%) had an unidentifiable cause of pain. Among the 13 patients who had shoulder pathology, only 1 (0.5%) underwent shoulder surgery.

CONCLUSION: For patients presenting to a shoulder surgeon's clinic for shoulder pain, 5% will turn out to have neck pathology. For patients presenting to a spine surgeon's clinic for neck pain, 6.5% will turn out to have shoulder pathology. Thus, approximately 1 in 20 patients seen at a surgeon's clinic for either a presumed shoulder or neck problem exhibit a neck-shoulder crossover, where pathology in one may be mistaken for or co-exist with the other.

SIGNIFICANCE: This data will help raise clinicians' awareness and suspicion of pain coming from either the neck or shoulder masquerading as the other. This will in turn likely lead to improved diagnostic accuracy and treatment success.

34. Anatomy of the Posterior Glenoid Labrum and Capsule of the Shoulder Joint: A Cadaveric Study

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INTRODUCTION: There is limited published data regarding the anatomy of the posterior glenohumeral capsulolabral complex. We sought to clarify the anatomy of the posterior capsular insertion as well as the footprint of the posterior labrum attachment to the glenoid neck with the goal of providing data that may facilitate the surgeon's ability to accurately repair these structures.

METHODS: Thirty (18 male, 12 female) cadaveric shoulders were dissected. The pattern of the posterior capsular insertion into the labrum or glenoid neck was recorded. The footprint of the posterior labral attachment to the glenoid neck was documented. All measurements were made with a digital caliper.

RESULTS: The posterior capsule inferior to the equator of the glenoid inserted directly into the leading edge of the labrum in 28 of 30 shoulders. In contrast, the capsular insertion in the posterior-superior quadrant of the glenoid was into the posterior edge of the labrum or directly into the glenoid neck at an average of 4.7 mm (2.7-8.5 mm) posterior to the glenoid rim. The average footprint width of the posterior labral attachment to the glenoid neck was 5.02 mm (3.0-7.3 mm). In 16 of the specimens, there was no extension of the attachment onto the glenoid face whereas in the other 14, the attachment extended onto the glenoid face by an average of 1.71 mm (1-4 mm).

DISCUSSION AND CONCLUSION: The inferior half of posterior glenohumeral capsule attaches directly to the labrum while the superior half of the capsule attaches medial to the labral edge, often directly onto the glenoid neck, resulting in a capsular pouch superiorly. The posterior labrum footprint starts at the glenoid rim and extends medially for an average of 5 mm. Extension of the labral attachment onto the glenoid face was seen in less than 50% of the specimens, and when seen, this extension averaged under 2 mm. This anatomic data may help guide accurate reconstruction of posterior capsulolabral anatomy. Suture anchors should be placed no more than 2 mm onto the glenoid face to avoid an excessive anterior position of the repair.

35. Biomechanical Comparison of Lesser Tuberosity Osteotomy vs. Subscapularis Tenotomy in Total Shoulder Arthroplasty

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BACKGROUND: Total shoulder arthroplasty is traditionally performed through an anterior deltopectoral exposure with subscapularis tenotomy. Postoperative subscapularis dysfunction is common and adversely affects clinical outcomes. Consequently, surgeon interest in lesser tuberosity osteotomy has grown in an effort to improve subscapularis repair strength. This study was performed to investigate the biomechanical strength of subscapularis tenotomy versus lesser tuberosity osteotomy in the setting of total shoulder arthroplasty.

METHODS: Twenty paired upper extremities from ten cadavers underwent humeral prosthesis placement. For each respective cadaver, one upper extremity limb underwent subscapularis osteotomy while the contralateral upper extremity underwent subscapularis tenotomy. The cadaveric specimens then underwent cyclic displacement and maximum load to failure testing.

RESULTS: The subscapularis tenotomy specimens exhibited significantly less cyclic displacement than the osteotomy group (0.8 mm for tenotomy versus 1.8 mm for osteotomy, p value=0.002). There was no significant difference between the groups in terms of maximum load to failure (439 ± 96 N for tenotomy and 447 ± 89 N for osteotomy, p=0.78).

CONCLUSION: Lesser tuberosity osteotomy was not significantly stronger than subscapularis tenotomy in maximum load to failure testing. Subscapularis tenotomy repair showed statistically significant less cyclic displacement than did the lesser tuberosity osteotomy group. Further research is needed to clarify how the biomechanical results immediately after subscapularis tenotomy and lesser tuberosity osteotomy correlate with clinical outcomes.

36. Structural Bone Grafting for Glenoid Bone Deficiency in Primary Total Shoulder Arthroplasty

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INTRODUCTION: Glenoid component failure remains a significant factor leading to prosthetic failure in total shoulder arthroplasty. Patients with compromised and deficient bone stock secondary to degenerative and inflammatory arthritis may be more prone to such failure. Alternatively, bone grafting can be used to help restore asymmetrically eroded glenoid bone stock to allow better glenoid support and positioning. There are few reports to date on this technique and its effect on mid-to-long term glenoid component survival.

METHODS: Between January 1, 1976, and December 31, 2008, 34 patients underwent structural bone grafting for glenoid deficiencies during total shoulder arthroplasties at our institution. Twenty-seven patients with complete preoperative and postoperative clinical and radiographic evaluation and a minimum of two-year follow-up or until the time of revision surgery were included in the study. The mean clinical follow-up was 8.4 years while the mean radiographic follow-up was 6.4 years. Radiographic outcome included immediate and most recent postoperative evidence of glenoid loosening and graft survival.

RESULTS: Range of motion improved an average of 60° (83° preoperatively, 144° postoperatively) for elevation and 40° (25° preoperatively, 63° postoperatively) for external rotation. A Neer rating of excellent was calculated for 18 patients, satisfactory for 6 and unsatisfactory for 3. Six patients had ≥ 1.5 mm of complete glenoid lucency while four patients had evidence of glenoid tilt and four patients had evidence of glenoid migration. Four patients required revision surgery.

CONCLUSION: Although structural bone grafting in total shoulder arthroplasty is uncommonly necessary, our results indicate that it may remain a viable option in the setting of glenoid deficiency. However, there was a moderate rate of periprosthetic lucency and evidence of component loosening.

37. Comparison of Glenohumeral Pressure Before and After Labral Repairs: Simple vs. Vertical Suture Pattern

(Unrestricted educational grants received from Arthrex, DePuy, and Smith & Nephew)

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INTRODUCTION: The purpose of this study was to evaluate the surface pressures caused by different suture patterns used in the treatment of anterior shoulder instability as a result of a Bankart lesion.

METHODS: Twenty, fresh-frozen human cadaveric shoulders were randomly assigned to one of two repair groups: simple suture repair and vertical mattress repair. A Tekscan pressure-mapping sensor was placed on the intact glenoid surface. A baseline measurement was taken for each specimen applying loads of 220N and 440N (3x for each load) through the humeral head. Pressure was recorded for 0°, 45°, and 90° of shoulder abduction. After creation of the Bankart lesion and repair, the pressure testing protocol was repeated. Mean contact pressure over the entire surface and peak force of the most loaded sensel were recorded. The repairs were then loaded to failure and peak load, and stiffness was recorded. Data comparing intact to repair were analyzed by repeated measures ANOVA and data comparing the two repairs were compared by paired t-test ($p<0.05$).

RESULTS: There was a significant ($p<0.05$) increase in contact pressure and the peak pressure after repair for both groups at 90° abduction at both 220 N and 440 N of force. There was a significant increase in peak pressure after repair for both groups at 45° abduction and 220 N of force. There was no significant difference between the two repair groups. There was no significant difference in peak load between the simple group (356 N) and the vertical group (396 N). There was no significant difference in stiffness between the simple group (38 N/mm) and the vertical group (40 N/mm).

DISCUSSION AND CONCLUSION: In our study, we found no significant difference in peak pressures and mean contact pressures between the simple repair group and the vertical repair group. This would suggest that pressure patterns may not be affected if the knot for a labral repair is placed on the articular surface versus outside the articular surface. We did find a significant increase in peak pressure and mean contact pressure in both repair groups which could lead to early degenerative changes in the joint.

PEDIATRICS

38. Definitive Nonoperative Treatment of Femoral Shaft Fractures in Young Children with Hip Spica Splinting

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INTRODUCTION: Femoral shaft fractures in children under five are typically treated with closed reduction and single leg hip spica casting. Hip spica splinting can be an alternative to casting for definitive treatment. The benefits of splinting are that it can easily be placed without the use of general anesthesia, can be applied in any setting such as the emergency department or a hospital room, and costs less.

METHODS: This study retrospectively evaluates 42 patients under five years of age with femoral shaft fractures who were definitively treated with hip spica splinting compared to five patients who were definitively treated with hip spica casting over a four-year period. All patients were treated by one orthopedic surgeon who applied the splints and casts.

RESULTS: All fractures healed in six weeks. At final healing, the average final anterior angulation was 11° and the average varus angulation was 13° in the splint group compared to the cast group, which had an average anterior angulation of 11° and an average varus angulation of 9°. Two patients in the splint group had varus angulations greater than 20°; however, one was due to a parent adjusting the position of the splint, resulting in 30° of varus angulation and the other had 27° of varus angulation after the splint broke at the level of the fracture. One patient in the cast group suffered skin ulcers due to excessive urine soiling.

DISCUSSION/CONCLUSION: Hip spica splinting offers similar results compared to hip spica casting when used as definitive treatment for femoral shaft fractures in children younger than five. The use of a hip spica splint has many advantages, which include the ease of application not requiring sedation or general anesthesia, easier maintenance of good hygiene, lower cost, and lower risk of sores from the cast or splint.

39. Evaluation of Outcomes of Complex Idiopathic Clubfeet

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SUMMARY: The mid-term outcomes of patients with complex clubfeet treated by a modified Ponseti technique were evaluated. The results demonstrate good outcomes 4-10 years after treatment even though relapses were more common than typical cases.

METHODS: Twenty-two patients with complex clubfeet (CCF) were evaluated with questionnaires, physical examination, and gait analysis. Their prior treatment history was obtained through chart review and included: prior treatment at outside institutions, number of casts, tenotomies, brace wear compliance, surgical releases, relapses, and tibialis anterior transfers (TAT). Statistical analysis was performed to evaluate: (1) relationship among brace compliance, relapses, and further treatment; (2) PODCI and DSI scores of CCF patients versus published norms; (3) physical examination findings of CCF feet/legs versus unaffected contralateral feet/legs; and (4) differences in gait temporal and spatial parameters in CCF patients versus published norms.

RESULTS: All patients were corrected by manipulation and casting, and no surgical releases were performed. PODCI and DSI scores of CCF patients are on average similar to published norms. Physical examination findings show a trend toward shorter feet, longer Achilles tendon, and smaller calf circumference than unaffected feet/legs. CCF patients experienced more relapses (59%) and require more TATs (45%) than patients with typical clubfoot. Gait analysis shows CCF patients to have similar gait characteristics to age matched normal controls.

CONCLUSION: CCF patients treated with the modified Ponseti technique have PODCI and DSI scores, and gait analysis measurements similar to age matched published norms. Physical examination findings characteristic for CCF include shorter feet, longer Achilles tendon, and smaller calf circumference. However, CCF patients have higher rates of relapse than typical clubfoot patients.

* = presenter

♦ Indicates those presentations in which the FDA has not cleared the drug and/or medical device for the use described (i.e., the drug or medical device is being discussed for an “off label” use).

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Amadio, Peter C.	4 – Johnson & Johnson, Merck; 7 – Journal of Bone and Joint Surgery-American, Saunders/Mosby-Elsevier
Amendola, Annunziato	1, 3b – Arthrex, Inc.; 1, 4 – Arthrosurface; 3b – Zimmer; 3c, 4 – MTP Solutions; 8 – Clinical Journal of Sports Medicine, Foot and Ankle International, Journal of the AAOS; 9 – American Board of Orthopaedic Surgery, Inc., American Orthopaedic Society for Sports Medicine, International Society of Arthroscopy, Knee Surgery, and Orthopaedic Sports Medicine
An, Kai-Nan	n
Anderson, Donald D.	4 – FxRedux Solutions, LLC
Anderson, John G.	4 – Pfizer; 9 – American Orthopaedic Foot and Ankle Society
Anderson, Kyle J.	1, 2, 3b, 6 – Arthrex, Inc.; 3a – Mitek; 8 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Anz, Allan G.	n
Aprato, Allessandro	n
Archdeacon, Michael T.	2 – Smith & Nephew; 3b – Stryker; 7 – SLACK Incorporated; 8 – Wolters Kluwer Health – Lippincott Williams & Wilkins; 9 – Orthopaedic Trauma Association
Armstrong, Tyler	3b - Genentech
Atanda, Abiola	n
Awad, Hani	n
Azar, Frederick M.	4 – Pfizer; 7 – Saunders/Mosby-Elsevier; 8 – American Journal of Sports Medicine; 9 – AAOS, Campbell Foundation, St. Jude Children's Research Hospital
Azzam, Khalid	n
Baca, Geneva	n
Bachmann, Keith	n
Bailey, Mark S.	n
Baker, Erin	n
Baker, Kevin C.	5 - Zimmer
Baker, Rodney K.	n
Banka, Trevor R.	n
Barlow, Jonathan D.	n
Barnes, C. Lowry	1, 3c, 5 – Wright Medical Technology, Inc.; 5 – ConforMIS, Johnson & Johnson, Stryker, Wright Medical Technology, Inc.; 8 – Clinical Orthopaedics and Related Research; Journal of Surgical Orthopaedic Advances, Journal of Arthroplasty; 9 – Arkansas Orthopaedic Society, Society for Arthritic Joint Surgery, Southern Orthopaedic Association
Barrack, Robert L.	1 – Smith & Nephew; 3b – Stryker; 5 – Biomet, EOS Imaging, Medical Compression Systems, National Institutes of Health (NIAMS & NICHD), Smith & Nephew, Stryker, Wright Medical Technology, Inc.; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins; 9 – American Association of Hip and Knee Surgeons, American Orthopaedic Association, Hip Society, Knee Society
Barsoum, Wael K.	1 – Exactech, Inc., Wright Medical Technology; 2, 3b, 5 – Stryker; 3b –

	Shukla Medical; 4 – Otismed; 5 – Active Implants, CoolSystems, Orthovita, Zimmer; 8 – Clinical Orthopaedics and Related Research; 9 – Mid-America Orthopaedic Association
Bauer, Thomas W.	4 – Alphatec Spine; 8 – Journal of Bone and Joint Surgery-American; Journal of Orthopaedic Research, Springer
Bava, Eric D.	n
Bawa, Harpreet S.	n
Beaule, Paul E.	1, 2, 3b, 4 – Wright Medical Technology, Inc.; 2, 3b – MEDACTA, Smith & Nephew; 3b, 5 – Corin U.S.A.; 7 – Journal of Bone and Joint Surgery-American
Becker, Hillary A.	n
Becker, Matthew L.	n
Beckert, Mitchell	n
Beckley, Tyler J.	n
Bedard, Nicholas A.	n
Behery, Omar A.	n
Bengero, Lowell	n
Bennett, James Michael	n
Bennion, Phillip W.	n
Berend, Keith R.	1, 3b, 5 – Biomet; 3b, 5 – Salient Surgical; 8 – Clinical Orthopaedics and Related Research, Journal of Arthroplasty, Journal of Bone and Joint Surgery-American, Orthopedics; 9 – American Association of Hip and Knee Surgeons
Berend, Michael E.	1, 3b, 5 – Biomet; 4 – Orthalign; 5 – ERMI; 8 – Journal of Arthroplasty; 9 – Piedmont Ortho
Berger, Richard A.	1 – Zimmer; 3b – Salient Surgical
Bergfeld, John A.	8 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Bergmann, Karl	n
Bernasek, Thomas L.	1, 3b – DePuy, a Johnson & Johnson Company; 5 – Corin U.S.A.
Berry, Daniel J.	1, 5 – DePuy, a Johnson & Johnson Company
Bershadsky, Boris	n
Bertone, Alicia L.	2 – Pall Corp.
Bey, Michael J.	5 – DJ Orthopaedics, Nike
Bhatia, Sanjeev	n
Bishop, Allen T.	9 – American Society for Reconstructive Microsurgery
Bishop, Gavin	n
Blackman, Andrew J.	n
Blaha, J. David	1, 3b – Wright Medical Technology, Inc.; 8 – Clinical Orthopaedics and Related Research, Journal of Arthroplasty, Journal of Bone and Joint Surgery-American; 9 – Michigan Orthopaedic Society
Bledsoe, J. Gary	5 – DePuy, a Johnson & Johnson Company
Blomberg, Josh R.	n
Boese, Clifford K.	2, 5 – DePuy, a Johnson & Johnson Company
Bohay, Donald R.	1, 2, 3b – BESPA Consulting; 5 – Research and Education Institute at Orthopaedic Associates of Michigan; 8 – Foot and Ankle International, Journal of Orthopaedics and Traumatology
Bois, Aaron J.	n
Bonasia, Davide E.	n
Bonner, Tara	n
Bono, Kenneth T.	n
Boone, Gregory R.	n
Born, Trevor R.	n
Boyer, Jeffrey S.	n
Bradley, Jeffrey M.	n

Briggs, Karen K.	5 – Össur, Smith & Nephew, Arthrex, Inc., Siemens
Brinson, Martha F.	n
Brogan, David M.	n
Brooks, Peter J.	3b – Smith & Nephew, Stryker
Brown, Thomas D.	3b – Smith & Nephew; 7 – Journal of Bone and Joint Surgery-American; 8 – Journal of Orthopaedics and Traumatology
Brown, Stephen L.	n
Bryan, Jason	n
Buckwalter, Joseph A.	3b – ISTO and Carbylan Bioscience, Musculoskeletal Transplant Foundation; 7, 8 – Journal of Orthopaedic Research; 9 – American Orthopaedic Association
Budge, Matthew	n
Buller, Leonard T.	n
Burgess, Mary	n
Burkhead, Wayne Z., Jr.	1, 2, 3b, 4 – Tornier; 3b, 5 – Wright Medical Technology; 3b – Stryker; 8 – Journal of Shoulder and Elbow Surgery; 9 – American Shoulder and Elbow Surgeons, International Board of Shoulder and Elbow Surgery
Burks, Robert T.	1, 2, 3b – Arthrex, Inc.; 9 – Arthroscopy Association of North America
Buss, Daniel D.	3b – Wright Medical Technology, Inc.; 4 – Disc Dynamics; 6 – Minnesota Twins; 9 – Medica Physician Advisory Board, United Healthcare Advisory Board
Butler, David L.	n
Butler, Sam (Robert)	n
Cabanela, Miguel E.	2, 3b – Stryker; 9 – International Hip Society, Mid-America Orthopaedic Association
Cable, Matthew G.	n
Callaghan, John J.	1 – DePuy, a Johnson & Johnson Company; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Callaghan, Katharine	n
Callanan, Mark C.	n
Calvert, Graham C.	n
Campacci, Antonio	n
Campion, Heather A.	n
Cannada, Lisa K.	2 – Smith & Nephew; 3b, 5 – Zimmer; 5 – Department of Defense, Southeast Fracture Consortium, Synthes; 8 – Clinical Orthopaedics and Related Research, Current Orthopaedic Practice, Geriatric Surgery and Rehabilitation, Journal of Bone and Joint Surgery-American, Journal of Orthopaedic Trauma, Journal of Traumatology
Carey, Patricia M.	n
Carson, William	1, 4 – Isola Implants Inc.
Cass, Joseph R.	2 – Synthes; 4 – Johnson & Johnson; 9 – AAOS, Orthopaedic Trauma Association
Cayo, Max	n
Chalmers, Peter N.	N
Chan, Philip	n
Chaubey, Aditya	n
Cheng, Edward Y.	1 – Innomed; 3b – Biomet; 6 – Musculoskeletal Transplant Foundation; 8 – Journal of Bone and Joint Surgery-American; 9 – Musculoskeletal Tumor Society
Cherney, Steve	n
Chimento, George F.	n
Choueka, Jack	n
Christie, Matthew	n

Christie, Michael J.	1 – DePuy, a Johnson & Johnson Company, Zimmer; 4 – Exactech, Inc.
Cil, Akin	2 – Arthrosurface
Clarke, Henry D.	3b – Biomet; 5 – Stryker; 8 – American Journal of Orthopedics Techniques in Knee Surgery, Journal of Knee Surgery; 9 – AAOS, Knee Society
Clohisy, John C.	3b – Biomet; 5 – Zimmer; 8 – Journal of Bone and Joint Surgery-American
Cofield, Robert H.	1 – DJ Orthopaedics, Smith & Nephew; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Colbrunn, Robb	n
Cole, Brian J.	1, 3b, 5 – Arthrex, Inc.; 1, 5 – DJ Orthopedics; 1, 7 – Lippincott; 1, 7, 8 – Elsevier; 2 – Genzyme; 3b – Zimmer, Carticept, Biomimmetic, Allosource, DePuy; 5 – Regentis, Smith & Nephew; 7 – W. B. Saunders; 8 – JBJS, AJSM, Cartilage, JSES, AJO
Cole, Peter A.	3b, 5 – Synthes; 5 – Acumed, DePuy, Smith & Nephew, Stryker, Zimmer
Comfort, Thomas K.	n
Connelly, Camille L.	n
Conoley, Jack A.	n
Connor, Patrick M.	1 – Biomet; 3b – Zimmer; 9 – NFLPS, OrthoCarolina Research Institute
Cordell, Cari L.	n
Crist, Brett D.	4 – Amedica Corporation; 5 – Medtronic, Novalign, Synthes, Wound Care Technologies; 8 – Journal of the AAOS, Journal of Orthopaedic Trauma, Your Orthopaedic Connection; 9 – Orthopaedic Trauma Association
Cross, William W., III	2 – Synthes; 3b – Innovative Medical Device Solutions
Cui, Shari	n
Culotta, Brad A.	n
Cusick, Michael C.	n
Daccarett, Miguel	n
Dahm, Diane L.	9 – Arthroscopy Association of North America, Research Committee
Dalury, David F.	1, 2, 3b, 5 – DePuy, a Johnson & Johnson Company; 8 – Journal of Arthroplasty
D'Alessandro, Donald F.	n
D'Apuzzo, Michele R.	n
Dart, Bradley R.	n
DeBoer, David K.	1 – DePuy, a Johnson & Johnson Company; 1, 3b – Wright Medical Technology, Inc.
DeClaire, Jeffrey H.	3a, 3b – TissueLink; 3b – Biomet
DeCoster, Thomas A.	2 – Zimmer; 4 – Merck, Pfizer, US Orthopedics; 8 – OKO; 9 – Orthopaedic Trauma Association
Della Rocca, Gregory J.	3b – Medtronic; 4 – Amedica, The Orthopaedic Implant Company, 5 – Kinetic Concepts, Inc., Smith & Nephew, Stryker, Synthes, Wound Care Technologies; 9 – Journal of the AAOS, Journal of Bone and Joint Surgery-American, Journal of Orthopaedic Trauma; 9 – AAOS, Orthopaedic Trauma Association
Della Valle, Craig J.	3b – Biomet, Convatec; 3b, 5 – Smith & Nephew; 4 – CD Diagnostics; 5 – Stryker; 7 – Journal of Bone and Joint Surgery-American; 7, 8 - SLACK Incorporated; 8 – Orthopedics Today; 9 – American Association of Hip and Knee Surgeons, Arthritis Foundation, Knee Society, Mid-America Orthopaedic Association
Dennison, David G.	2 – AO; 5 – DePuy, a Johnson & Johnson Company
Derwin, Kathleen A.	1, 5, 6 – Musculoskeletal Transplant Foundation; 8 – Journal of Bone

	and Joint Surgery-American; 9 – Orthopaedic Research Society
DeSimone, Lori J.	n
Dilisio, Matthew F.	n
Dirschl, Doug R.	1 – Biomet; 3b – Amgen, Stryker; 9 – American Orthopaedic Association
Do, Pat D.	n
Dobbs, Ryan E.	4 – Orthopaedic Implant Company
Dolan, Lori	9 – Scoliosis Research Society
Dolan, Mark	n
Dombrowski, John	n
Dunkin, Brad S.	n
Duryea, Jeffrey	n
Dutta, Anil K.	1 – Ortho Helix; 2, 3b - Tornier
Easton, Robert	n
Ebenezer, David S.	n
Edwards, Sara L.	n
Elhassan, Bassem T.	n
Elkins, Jacob	n
Eller, Erik B.	n
Ellis, Thomas J.	1 – Acute Innovations; 3b – Smith & Nephew; 3b, 5 – Stryker; 9 – Foundation Orthopaedic Trauma
Endres, Terrence J.	2 – AONA speaker
Engh, C. Anderson, Jr.	1, 3b, 4, 5 – DePuy, a Johnson & Johnson Company; 5 – Inova Health Care Services, Smith & Nephew; 9 – American Association of Hip and Knee Surgeons
Erdemir, Ahmet	n
Erez, Orry	n
Erickson, Jill	n
Esquivel, Amanda O.	6 – Arthrex, Inc.
Evans, Peter J.	2, 3b – Small Bone Innovations; 2, 3b, 4 – Nutek; 2 – Synthes; 3b – Axogen, Biomet, Extremity Medical, Mitek
Fabec, Diane	n
Fajardo, Roberto J.	n
Fehringer, Edward V.	1, 2, 4, 5 – Tornier; 7 – Elsevier; 8 – Journal of Shoulder and Elbow Surgery; 9 – Nebraska Orthopaedic Society
Fening, Stephen D.	n
Fisher, David A.	1, 2, 3b, 5 – DePuy, a Johnson & Johnson Company; 3c, 4 – Orthopediatrics; 4 – Eli Lilly, Pfizer, Tornier, Visible Assets; 4, 5 – Incisive Surgical
Fisher, Kimberly A.	n
Fishman, Matthew P.	n
Fitzgibbons, Timothy C.	n
Flanigan, David C.	2 – Genzyme; 3b, 6 – Smith & Nephew; 6 – Arthrex, Inc., Biomet, Mitek
Fleissner, Courtney	n
Flesichli, James	5 – Biomet
Flynn, Jeffrey C.	9 – American Board of Medical Laboratory Immunology
Franz, Justin O.	n
Freehill, Michael Q.	3b – Wright Medical Technology, Inc.; 5 – Tornier
Freeman, Katie	n
French, Bruce G.	8 – Journal of Orthopedic Trauma
Froimson, Avrum I.	n
Froimson, Mark I.	1, 3b – DePuy, a Johnson & Johnson Company; 2 – Cadence Pharmaceutical; 4, 6 – Medical Compression Systems; 6 – TissueLink; 8 – American Journal of Orthopedics; 9 – American Association of Hip

	and Knee Surgeons, Mid-America Orthopaedic Association
Fruehling-Wall, Catherine	n
Futvoye, Matthew C.	4 - Stryker
Gallo, Theresa J.	n
Ganz, Reinhold	3b – Lima Corporate; 3c, 4 - Pivot
Gao, Tianming	n
Gao, Yubo	n
Garcia, E'Stephen J.	n
Garvin, Kevin L.	1 – Biomet; 8 – Wolters Kluwer Health – Lippincott Williams & Wilkins; 9 – AAOS, American Orthopaedic Association
Gauger, Erich M.	n
Gerson, James N.	n
Ghate, Raju S.	3b - Zimmer
Ghattas, Timothy N.	n
Ghodadra, Neil S.	n
Gillette, Blake P.	n
Gioe, Terence J.	4 – Eli Lilly, Johnson & Johnson; 5 – DePuy, a Johnson & Johnson Company; 9 – American Board of Orthopaedic Surgery, Inc., American Joint Replacement Registry
Giuseffi, Steven A.	n
Giveans, M. Russell	n
Goetz, Devon D.	8 – Clinical Orthopaedics and Related Research; 9 – Society for Arthritic Joint Surgery
Goldberg, Victor M.	2, 3b – Astrazenica, Osteotech; 4 – TissueLink; 5 – NIH, Sultzer/ Zimmer; 7 – Elsevier; 8 – Clinical Orthopaedics and Related Research, Journal of Bone and Joint Surgery-American, Journal of Orthopaedic Research, Osteoarthritis and Cartilage; 9 – Bioinnovations Institute, OASRI
Goldstein, Steven A.	1 – Zimmer Biomineral Holdings Inc.; 3b – Synthes; 4 – Amgen Co., Fate Therapeutics BioMatrix Photonics; 5 – Synvasive; 8 – Journal of Biomechanics, Journal of Cell and Molecular Bioengineering, Journal of Orthopaedic Research
Golnick, Phillip M.	n
Goodwin, Ryan C.	3b – Stryker
Gordon, J. Eric	1, 3b - Orthopediatrics
Gothard, M. David	n
Gould, John S.	3c – Paragon 28, Tornier; 8 – American Journal of Orthopedics, International Orthopaedics; 9 – Alabama Orthopaedic Society, AAOS
Goulet, James A.	1 – Zimmer; 2 – Smith & Nephew; 9 – American Orthopaedic Association, Orthopaedic Trauma Association
Gourineni, Prasad V.	4 – G2Healthcare
Gradisar, Ian	n
Grappiolo, Guido	1, 2, 3b – Zimmer; 2, 3b – Biomet; 3c – Lima, Finceramica; 5 – Sanofi-Aventis
Graves, Matthew L.	2, 3b, 5 – Synthes; 5 – Stryker; 8 – Journal of Orthopaedic Trauma; 9 – Orthopaedic Trauma Association Education Committee
Grawe, Brian	n
Gray, Robert R.	n
Graziano, Gregory P.	3c – Medtronic Sofamor Danek; 8 – The Spine Journal; 9 – AAOS, Mid-America Orthopaedic Association
Green, Charles	n
Greis, Patrick	4 – Merck
Grier, Kathleen M.	n
Griffith, Timothy B.	n

Gross, Thomas P.	1, 3c – Biomet
Guanciale, Anthony F.	9 – North American Spine Society
Guerra, James J.	n
Guettler, Joseph H.	4 – Genzyme, Johnson & Johnson, Stryker; 5 – DePuy, a Johnson & Johnson Company, Omeros; 9 – American Orthopaedic Society for Sports Medicine
Guo, Xin	n
Gupta, Asheesh	n
Haider, Hani	2 – Government of Brazil (INMETRO); 3b – AMTI Inc., Orthopedic Surgical Manufacturers Association (OSMA); 4 – SI-BONE, Softjoint; 5 – Arthrex, Inc., Biomet, Department of Defense, Empirical Testing Company, Exponent, Ortho Development, Tornier; 6 – DeSoutter; 8 – (Journal) Advances in Orthopedics, Journal of Engineering in Medicine; 9 – AAOS Biomedical Engineering Committee, International Society for Technology in Arthroplasty
Haladik, Jeffrey A.	n
Hall, Justin M.	n
Hammer, Lindsay P.	n
Hankins, Daniel T.	n
Hanna, Jason D.	6 – Arthrex, Inc.
Hanssen, Arlen D.	1, 5 – Stryker; 7 – Elsevier; 9 – Knee Society
Harmsen, William S.	n
Harris, Joshua D.	n
Harrison, Alicia K.	9 – American College of Surgeons
Harrison, Heather R.	n
Harrison, Ryan K.	n
Hart, Eric	n
Hartigan, David E.	n
Hatzidakis, Armodios M.	2, 3b, 4, 5 - Tornier
Hartzler, Robert U.	n
Hasan, Saqib	n
Hasan, Syed A.	9 - AAOS
Hayden, Brett	n
Hecht, Garin	n
Hennessy, David W.	n
Herkowitz, Harry N.	1 – Medtronic; 3b, 4 – Globus Medical 3b – Stryker; 7, 8 – Saunders/Mosby-Elsevier; 9 – American Board of Orthopaedic Surgery, Inc.
Herrera, Diego	n
Herzog, Mary A.	n
Higuera, Carlos A.	n
Hinkin, Stephen	n
Ho, Jason C.	n
Hodrick, Jeffrey T.	n
Hoegler, Joseph J.	n
Hoffmann, Martin F.	n
Holcombe, Sven A.	n
Holmes, George B.	1, 2, 3b – Arthrex, Inc.; 8 – Foot and Ankle International Journal of the AAOS
Holmes, James R.	n
Hood, Michael A.	n
Horazdovsky, Ryan D.	n
Horton, Walter, Jr.	n
Hsu, Andrew R.	n

Huang, Ann	n
Hussey, Michael M.	n
Huston, Kellen L.	n
Hyden, John	n
Iannotti, Joseph P.	1, 3b – DePuy, a Johnson & Johnson Company; 3b – Biomet, Tornier, Wyeth; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins; 8 – Journal of Shoulder and Elbow Surgery
Inda, David J.	n
Inzana, Jason	n
Israel, Heidi	n
Jackson, Nancy M.	n
Jacobs, Joshua J.	3b – Johnson & Johnson, Smith & Nephew, Spinal Motion; 3b, 5 – Medtronic Sofamor Danek, Zimmer; 3c, 4 – Implant Protection; 7 – Taylor and Francis
Jacobson, Aaron	n
Jaffery, Hadia	n
Jawa, Andrew	n
Jawanlal, Aneel	n
Jenkins, Tyler	n
Jiang, Xi	n
Joglekar, Siddharth B.	n
Johnson, Jeffrey E.	1, 3b, 4 – OrthoHelix Surgical Designs, Inc.; 3b, 5 – Midwest Stone Institute, Inc.; 3b – MiMedx Group; 4 – Midwest Therapy, LLC; 8 – American Journal of Orthopedics, Foot and Ankle International, Techniques in Foot and Ankle Surgery; 9 - AAOS
Johnson, Jeffrey S.	n
Johnston, Richard C.	n
Jones, Clifford B.	2 – AONA; 8 – CORR, JBJS, JBJS Trauma Newsletter, Journal of Orthopaedic Trauma, Journal of Trauma, OCNA; 9 – AOA Own the Bone Board; Mid-America Orthopaedic Association, Michigan Orthopaedic Society, OTA Outcomes and Classification Committee
Jones, David B.	n
Jones, Morgan H.	5 - Arthrosurface
Jones, Teresa L.	n
Jové, Nathan	2 – Canyon Pharmaceutical; 3b – Aesculap, Smith & Nephew
Jump, Seth S.	n
Kaeding, Christopher C.	n
Kakar, Sanjeev	n
Kalawadia, Jay V.	n
Kaminski, Edward	n
Kancheria, Vamsi	n
Kang, Kevin	n
Kang, Sang Hoon	n
Kanu, Okezika C.	n
Karam, Matthew D.	n
Karas, Vasili	n
Karges, David E.	n
Karnes, Jonathan M.	n
Kassel, Cale A.	n
Kaufman, Kenton R.	1 – Otto Bock HealthCare; 8 – Gait and Posture, Prosthetics and Orthotics International
Keene, James S.	9 – American Orthopaedic Society for Sports Medicine
Keeney, James A.	9 – Society of Military Orthopaedic Surgeons, AAOS Board of Specialty Societies

Kelley, Scott S.	n
Kelm, Michael A.	n
Kemppainen, John W.	n
Kent, David M.	2 – Gore, Novartis
Kenter, Keith	9 – AAOS, American Board of Orthopaedic Surgery, Inc., American Orthopaedic Association, American Orthopaedic Society for Sports Medicine, Mid-America Orthopaedic Association
Khalil, Jad G.	6 – GE Healthcare
Khazzam, Michael S.	n
Khoury, Basma	n
Kiewiet, Nathan J.	n
Kilcoyne, Kelly G.	n
Killeen, Kathy	n
Kim, Young-Jo	3b – Arthrex, Inc.; 3c, 5, 6 – Siemens Health Care; 4 – Proctor & Gamble
Kink, Shaun	4 – Mylan Pharmaceuticals
Kirk, Jenna	n
Kittur, Nupur D.	n
Klapach, Aimee S.	n
Klaassen, Alison	n
Klika, Alison K.	n
Klika, Brian J.	n
Klimaski, David J.	n
Klingele, Kevin E.	n
Klocke, Noelle	n
Knapik, Derrick M.	n
Kodali, Pradeep	5 – Arthrex, Inc.
Kolowich, Patricia A.	8 – AJSM; 9 – American Orthopaedic Society for Sports Medicine (2011), Medical Publishing Board of Trustees (AJSM)
Koplas, Monica C.	n
Koreckij, Theodore D.	n
Kovacevic, David	n
Kraay, Matthew J.	3c – Zimmer; 9 – AAOS, Arthritis Foundation
Krempec, Jeffrey A.	n
Krishnan, Sumant G.	1, 2, 3b, 6 – Tornier; 1, 3b – TAG Medical; 1 – Össur; 6 – DePuy Mitek; 7 – Wolters Kluwer; 8 – JBJS, JSES, AJSM; 9 – ASES, AANA
Kudrna, James C.	1, 2, 3b, 4 – DePuy, a Johnson & Johnson Company; 1 – Innomed; 2 – Convatec
Kueny, Rebecca	n
Kuhl, Lori L.	n
Kurdziel, Michael	n
Kwon, Young W.	3b – Exactech, Inc., Smith & Nephew
Labib, Sameh A.	2 – Arthrex, Inc.; 4 – ConforMIS, Inc., Zimmer; 9 – AAOS, American Orthopaedic Foot and Ankle Society
Langer, Jakub S.	n
Larson, A. Noelle	n
Larson, Christopher M.	3b, 5 – Smith & Nephew; 3b, 4 – A2 Surgical
Lawton, Jeffrey N.	3b – Innomed, SBI
Le, Theodore T.	n
Ledonio, Charles Gerald T.	3b – Sterilmed, Inc.
Lee, Kyla R.	n
Legakis, Julie	n
Lehmann, Charles L.	4 - Orthovita
Lemos, Stephen E.	8 – American Journal of Sports Medicine, The Journal of Arthroscopy

	and Related Research; 9 – CORD – AOA, Michigan Orthopaedic Society
Lerner, Benjamin A.	n
Lervick, Gregory N.	n
Levine, Brett R.	3b, 5 – Zimmer; 5 – Biomet; 8 – Orthopedics, SLACK Incorporated; 9 - AAOS
Levy, Bruce A.	1 – VOT Solutions; 3b, 5 – Arthrex, Inc.; 5 – Biomet; 8 – Arthroscopy, Journal of Knee Surgery, Knee Surgery, Sports Traumatology; 9 – Arthroscopy Association of North America
Lewallen, David G.	1 – Orthosonics, Osteotech, Zimmer; 8 – Clinical Orthopaedics and Related Research; 9 – American Joint Replacement Registry, Hip Society, Mid-America Orthopaedic Association, OREF
Lincoln, Denis	4 – Medgenesis Therapeutix Inc.
Lindgren, Kevin E.	n
Liu, Steve S.	n
Liudahl, Adam	n
Lo, Winifred	n
Lock, Terrence R.	n
LoGrasso, Mary Ellen	n
Lonergan, Tim	n
Luna, Jeffrey Thomas P.	n
Luo, Michael	n
Luther, Aman	n
Lynch, Jamie L.	6 – Arthrex, Inc., Smith & Nephew
Lynch, T. Sean	n
Mabry, Tad M.	4 – Merck, Pfizer
Maerz, Tristan	n
Mageswaran, Prasath	n
Mahoney, Craig R.	5 – Smith & Nephew; 9 – Mid-America Orthopaedic Association
Malawer, Martin M.	n
Malchau, Henrik	1, 3b, 5 – Smith & Nephew; 3b, 5 – Biomet; 4, 6 – RSA Biomedical Inc.; 5 – DePuy, MAKO, Zimmer
Manivel, J. Carlos	n
Manning, David W.	1, 3b – Biomet; 2, 3b – Medacta; 2 – ConforMIS; 4 – Iconacy; 9 – AAOS
Marberry, Kevin M.	n
Marcus, Randall E.	4 – Medtronic, Steris, Stryker; 8 – Clinical Orthopaedics and Related Research; 9 – American Board of Orthopaedic Surgery, Inc., Association of Bone and Joint Surgeons
Marecek, Geoffrey S.	n
Markel, David C.	2, 3b, 4, 5 – Stryker; 4 – Biogen, Novi Bone and Joint Center, 8 – Clinical Orthopaedics and Related Research, Journal of Arthroplasty, Journal of Bone and Joint Surgery-American, Osteoarthritis and Cartilage; 9 – AAOS, Michigan Orthopaedic Society
Markiewitz, Andrew D.	7 – CRC Press; 8 – Journal of Bone and Joint Surgery-American, Journal of Hand Surgery-American; 9 – AAOS, Mid-America Orthopaedic Association
Marquez-Lara, Alejandro	n
Marsh, J. L.	1 – Biomet; 4 – FxRedux; - 7 – Oxford Press; 9 – American Board of Orthopaedic Surgery, Inc., American Orthopaedic Association, Orthopaedic Trauma Association
Martell, John M.	3b – Biomet, Harris Foundation, Smith & Nephew, Zimmer
Martin, Scott D.	n
Martinez, Sandy F.	n

Massè, Alessandro	n
Matsuda, Dean K.	1 – Arthrocare, Smith & Nephew, Biomet; 8 – Arthroscopy, Orthopedics Today; 9 – Orthopedics Overseas
May, Larry	n
May, Rick	n
Mayer, Mark	n
Mayerson, Joel L.	8 – Journal of Surgical Oncology; 9 – AAOS, Musculoskeletal Tumor Society, National Comprehensive Cancer Network, Ohio Orthopaedic Society
McAndrew, Christopher	n
McCarron, Jesse A.	1 – Musculoskeletal Transplant Foundation; 2, 3b – Acumed, LLC
McCarty, L. Pearce, III	n
McCormick, Frank	n
McCormick, Joseph	n
McCoy, Brett W.	n
McDonald, Douglas J.	3a, 3b – Smith & Nephew; 5 – Stryker; 9 – Musculoskeletal Tumor Society
McIntosh, Amy L.	3b – Synthes; 9 – Mid-America Orthopaedic Association
McLain, Robert F.	n
McLaughlin, Jeffrey R.	1, 2, 3b, 5 - Biomet
McMullen, Kathleen M.	n
McMullen, Scott T.	4 - Orthologic
McQueen, Melanie	n
Mehle, Susan C.	n
Mehlhoff, Thomas L.	n
Mehta, Sanjay	n
Meisel, Adam F.	n
Meisles, Diane	n
Meisles, Jeffrey S.	2, 3b – Zimmer; 4 – Abbott, Bristol-Myers Squibb
Mesiha, Mena M.	n
Mesko, Nathan W.	3c – DePuy, a Johnson & Johnson Company; 9 – AAOS, American Association of Hip and Knee Surgeons
Michalson, Jared L.	n
Midura, Ronald	n
Miller, Benjamin J.	9 – Musculoskeletal Tumor Society
Miller, Emily J.	n
Miller, Matthew A.	n
Miller, Robert H.	7 – Saunders/Mosby-Elsevier; 8 – American Journal of Sports Medicine
Millis, Michael B.	7, 8 – Saunders/Mosby-Elsevier; 8 – Springer
Mills, Emily	n
Milshteyn, Michael	n
Miniaci, Anthony	1, 2, 3b, 4, 6 – Arthrosurface; 3b – Smith & Nephew; 3b, 4, 6 – Stryker; 4 – DePuy, a Johnson & Johnson Company, Medtronic, Zimmer; 9 – American Orthopaedic Society for Sports Medicine, American Shoulder and Elbow Surgeons, Arthroscopy Association of North America, International Society of Arthroscopy, Knee Surgery, and Orthopaedic Sports Medicine
Mirza, Amer J.	2, 3b, 3c – Acumed, LLC; 3c – Seattle Information Systems
Mitchell, Erika J.	n
Moed, Berton R.	1 – DePuy, a Johnson and Johnson Company; 7, 8 – Clinical Orthopaedics and Related Research; 8 – Injury, Journal of Orthopaedic Trauma
Moeller, Amy T.	n
Monaco, Feno	n

Moore, Drew D.	n
Moore, Will	n
Moran, Steven L.	1, 2 – Ascension; 8 – Journal of Hand Surgery-American
Morandi, Massimo M.	n
Morcuende, Jose A.	9 – AAOS, Pediatric Orthopaedic Society of North America, U.S. Bone and Joint Initiative
Morgan, Robert A.	n
Moric, Mario	n
Mormino, Matthew A.	8 – Journal of the AAOS, Journal of Surgical Education; 9 – Mid-America Orthopaedic Association
Morrey, Bernard F.	1 – SBI DonJoy; 3a – Tenex Health; 3b – Zimmer; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins Elsevier
Morrey, Mark E.	n
Morrison, J. Craig	2 – DePuy, a Johnson & Johnson Company
Morscher, Melanie A.	4 – Bristol-Myers Squibb, Merck, Pfizer
Mott, Michael P.	4 – Johnson & Johnson; 9 – Mid-America Orthopaedic Association
Murray, Trevor G.	n
Murtha, Yvonne M.	n
Naranje, Sameer	n
Nasr, Kerellos	n
Nat, Dyment	n
Nelson, Ian	n
Nepple, Jeffrey J.	n
Ng, Vincent Y.	n
Nguyen, Mihn D.	n
Nielsen, Paul	n
Nies, Matthew S.	n
Noe, Donald A.	n
Noel, Curtis R.	2, 3b – Exactech, 5 – Arthrex, Inc., Breg, Tornier
Noiseux, Nicolas O.	3b – Wright Medical Technology, Inc.
Norton, Adam	n
Novais, Eduardo N.	n
Nuber, Gordon W.	4 – Johnson & Johnson, Stryker; 5 – Sage Pharmaceuticals
Nuismer, Amy	n
Nunley, Ryan M.	3b – CardioMEMS, Salient Surgical; 3b, 5 – Smith & Nephew, Wright Medical Technology; 5 – Biomet, EOS Imaging, Medical Compression Systems, Stryker
Nystrom, Lukas M.	n
O'Boynick, Christopher P.	n
O'Donnell, June	n
Olivo, Kristy	2 – mother spoke for Dermascience Fall 2010; 8 – mother serves on Ostomy Wound Management Editorial Board and is an associate editor for JWCET; 9 – mother is committee member of WCET
Olvey, Stephen E.	n
Omae, Hiromichi	n
Oman, Janine	n
Onyekwelu, Ikemefuna	n
Orfaly, Robert M.	1, 3b – Acumed, LLC; 2 – MicroAire Surgical Instruments, LLC; 9 – AAOS, Oregon Association of Orthopaedists; Oregon Medical Association
Owens, Brett D.	3b – Musculoskeletal Transplant Foundation; 8 – American Journal of Sports Medicine, Journal of Surgical Orthopaedic Advances, Orthopedics, Orthopedics Today; 9 – American Orthopaedic Society for Sports Medicine; Society of Military Orthopaedic Surgeons

Owens, Christopher J.	n
Pagnano, Mark W.	1 – DePuy, a Johnson & Johnson Company, MAKO, Stryker; 5 – Zimmer; 7, 8 – Clinical Orthopaedics and Related Research; 9 – AAOS, Knee Society
Pagnotto, Michael R.	4 – Bayer AG, MAKO Surgical Corp.; 7 – Mindworks Communications, a Wyanoke Group Company
Paik, Ronald S.	n
Paisley, Kevin C.	n
Pandhi, Nikhil	n
Paprosky, Wayne G.	1 – Wright Medical Technology; 1, 2, 3b – Zimmer; 3b – Biomet; 7, 8 – Journal of Arthroplasty; 9 – Hip Society
Parker, Richard D.	2 – Smith & Nephew Endoscopy; 2, 3b, 5 – Zimmer; 3b – Smith & Nephew
Parratte, Sebastien	n
Parvizi, Javad	3b – Biomet, Covidien, Salient Surgical, Smith & Nephew, TissueGene; 3b, 5 – National Institutes of Health (NIAMS & NICHD), Stryker, Zimmer; 5 – 3M, Musculoskeletal Transplant Foundation; 7 – Saunders/Mosby-Elsevier, Wolters Kluwer Health – Lippincott Williams & Wilkins; 7, 8 – SLACK Incorporated; 8 – American Journal of Orthopedics, Current Opinion in Orthopaedics, International Orthopaedics, Journal of the AAOS, Journal of Bone and Joint Surgery-American, Journal of Bone and Joint Surgery-British, Orthopedics Today; 9 – American Association of Hip and Knee Surgeons, American Board of Orthopaedic Surgery, Inc., British Orthopaedic Association, CD Diagnostics, Eastern Orthopaedic Association, Hip Society, OREF, Orthopaedic Research Society, SmartTech, United Healthcare
Pashos, Gail	4 - GlaxoSmithKline
Patel, Anay R.	n
Patel, Arpan	n
Patel, Jignesh	2 - Genzyme
Patel, Nilesh	n
Patel, Ronak M.	n
Patel, Shaun P.	n
Pedersen, Douglas R.	n
Pedroza, Angela	n
Pelt, Christopher E.	n
Periyasamy, Ramesh	n
Perry, Kevin I.	n
Peters, Christopher L.	1, 2, 3b – Biomet; 8 – Journal of Arthroplasty; 9 - AAOS
Petersilge, William J.	n
Peterson, Blake	n
Pfeiffer, Ferris	n
Pham, Anh	n
Philippon, Marc J.	1, 3b, 5, 6 – Smith & Nephew; 1 – Bledsoe, Donjoy; 1, 4 – Arthrosurface; 4 – Hipco, MIS; 7 – SLACK Incorporated, Elsevier; 9 – International Society for Hip Arthroscopy, AOSSM, Steadman Philippon Research Institute
Phisitkul, Phinit	4 – MTP Solutions; 9 – American Orthopaedic Foot and Ankle Society
Pickering, Trevor R.	n
Pifer, Matthew A.	n
Place, Howard M.	3b – Orthofix, Inc.; 9 – Scoliosis Research Society
Plantikow, Carla J.	n
Podeszwa, David A.	9 – Pediatric Orthopaedic Society of North America
Poka, Attila	n

Polkowski, Gregory G., II	n
Pollock, Anthony A. G.	n
Polly, David W., Jr.	2, 3b – Medtronic Spine ended 09/30/09; Medtronic Navigation ended 06/28/10; 9 – Scoliosis Research Society ended 09/17/10
Polster, Josh	n
Popa, Matthew A.	n
Popkin, Charlie	n
Potter, G. David	n
Potts, Aaron D.	n
Puri, Lalit	1, 3b – Stryker; 1 – Innomed; 3b – Salient Surgical; 5 - OREF
Puryear, Aki S.	3b – Globus Medical Medicrea; 3c – K2M
Quinn, Michael J.	n
Rabuck, Stephen J.	5 – Arthrex, Inc.
Rauls, Russell B.	n
Rausch, Matthew	n
Reams, Megan	n
Rees, Harold W.	n
Ren, Weiping	n
Reynolds, Richard A. K.	n
Rhee, Peter C.	n
Ricchetti, Eric T.	n
Richards, Daniel	n
Richardson-Frazzitta, Meagen	n
Riley, Patrick M., Jr.	n
Rill, Brian K.	n
Ringler, James R.	n
Ritzman, Todd F.	n
Rivkin, Gurion	n
Roberson, Rowland M.	n
Roberts, Craig S.	5 – Synthes; 7 – Skeletal Trauma; 8 – Injury, Journal of Orthopaedic Trauma, 9 – AAOS, Kentucky Orthopaedic Society, Mid-America Orthopaedic Association, Orthopaedic Trauma Association
Roberts, David W.	n
Romeo, Anthony A.	1, 2, 3b, 5, 6 – Arthrex, Inc.; 2, 5, 6 – DJ Orthopaedics; 2 – Joint Restoration Foundation; 7 – Saunders/Mosby-Elsevier; 8 – Arthroscopy, Journal of Shoulder and Elbow Surgery, SLACK Incorporated, Wolters Kluwer Health – Lippincott Williams & Wilkins
Romine, Lucas B.	n
Rose, Peter S.	9 – AAOS, Minnesota Orthopaedic Society
Rosenberg, Aaron G.	1, 2, 3b, 4 – Zimmer; 2, 3b – Salient; 7 – Wolters Kluwer Health – Lippincott; 8 – American Journal of Orthopedics, Knee, Orthopedics Today, SLACK Incorporated, Wolters Kluwer Health - Lippincott
Rosneck, James T.	n
Ross, James R.	n
Rossi, Roberto	n
Rothman, Richard H.	1, 3b – Stryker; 7, 8 – Journal of Arthroplasty
Rothy, Alex	n
Rowe, David	n
Rubash, Harry E.	1, 5 – Zimmer; 5 – Biomet; 9 – Hip Society
Rufo-Smith, Candace	n
Ruh, Erin L.	n
Russell, George V., Jr.	2 – AONA; 3b – Acumed, LLC; 4 – Zimmer; 5 - Synthes
Ryan, John M.	n
Rybarczyk, Jeffrey T.	n

Sabesan, Vani J.	9 – Ruth Jackson Orthopaedic Society
Salazar, Dane H.	n
Saltzman, Matthew D.	2 – CareFusion, DJ Orthopaedics; 5 – Arthrex, Inc.
Saluan, Paul M.	2 – Arthrex, Inc.; 3c – Triatrix, LLC; 5 - Zimmer
Samaan, Sam	n
Samuelson, Eric M.	n
Sanchez-Sotelo, Joaquin	1, 5 – Stryker; 5 – DePuy, Zimmer; 8 – Journal of Shoulder and Elbow Surgery
Sandzén, Sigurd C.	n
Santangelo, Kelly S.	n
Santos, Edward Ranier G.	n
Sarim, Ahmed	n
Sassoon, Adam A.	n
Saucedo, James M.	n
Savage, Jason W.	n
Schaaf, Adam	n
Scharschmidt, Thomas J.	n
Schiff, Adam P.	n
Schleck, Cathy D.	n
Schoch, Bradley S.	n
Schoenecker, Perry L.	8 – Journal of Children's Orthopaedics, Journal of Pediatric Orthopedics
Schrickel, Tyson T.	n
Schroeder, Matthew	n
Schub, David	n
Schwartz, Daniel G.	n
Sembrano, Jonathan N.	5 – Nuvasive; 9 – North American Spine Society
Sems, S. Andrew	1 – DePuy, a Johnson & Johnson Company
Severson, Erik P.	n
Shah, Ritesh R.	n
Sharma, Amit K.	n
Shaughnessy, William J.	8 – Journal of the AAOS; 9 – Pediatric Orthopaedic Society of North America
Sherman, Seth	n
Shin, Alexander Y.	5 – American Association for Hand Surgery, Integra Life Sciences, Musculoskeletal Transplant Foundation, Sonoma Orthopedics; 8 – Journal of Bone and Joint Surgery-American, Journal of Hand Surgery-American; 9 – American Society for Surgery of the Hand
Shishani, Yousef	n
Shives, Thomas C.	1 – DJ Orthopaedics
Sibole, Scott C.	n
Siebenrock, Klaus	n
Siebler, Justin C.	n
Siegel, Geoffrey	n
Siegel, Herrick J.	3b – Acumed, LLC; 8 – Journal of Foot and Ankle Surgery
Sierra, Rafael J.	2 – Arthrex, Inc.; 2, 3b – Biomet; 5 – DePuy, a Johnson & Johnson Company, Stryker, Zimmer; 9 – American Association of Hip and Knee Surgeons, Maurice Mueller Foundation; Mid-America Orthopaedic Association
Sietsema, Debra L.	2, 3b – Eli Lilly; 9 – American Orthopaedic Association Own the Bone, Bone and Joint Initiative, NOF Nursing Advisory Council, NAON, RN-AIM Research Council, Orthopaedic Trauma Association
Silverman, Andrew M.	n
Sim, Franklin H.	7 – Saunders/Mosby-Elsevier

Sink, Ernest L.	3b – Pivot; 9 – Pediatric Orthopaedic Society of North America
Siston, Robert A.	n
Slinkard, Nathaniel	n
Sloan, Caitlin	n
Smith, Laura A.	n
Smith, Lori L.	n
Smith, Matthew V.	n
Smith, Richard	n
Smith, Travis H.	3a – Medical Science Products, Inc.
Souza, Bruno Goncalves Schroder	n
Speering, Leann M.	n
Sperling, John W.	n
Spinner, Robert J.	3b – Mayo Medical Ventures; 8 – Clinical Anatomy, Journal of Surgical Orthopaedic Advances, Mayo Clinic Proceedings, Neurosurgery, World Neurosurgery; 9 – American Society for Peripheral Nerve
Sporer, Scott M.	3b – Smith & Nephew, Zimmer; 5 – Central Dupage Hospital; 7 – SLACK Incorporated
Stack, Melinda	n
Stannard, James P.	2, 3b – KCI, Medtronic Sofamor Danek; 3b – Sonoma; 7 – Theime; 8 – Journal of Knee Surgery; 9 – Orthopaedic Trauma Association
Stans, Anthony A.	n
Stark, John G.	1, 4 – Ilion Medical; 2, 3b, 3c, 4, 6 – Signus Medical
Staron, Jeffrey S.	n
Steinmann, Scott P.	1, 3b – DePuy, a Johnson & Johnson Company; 3b – Arthrex, Inc.; 7 – Journal of Hand Surgery-American, Journal of Shoulder and Elbow Surgery, Yearbook of Hand Surgery
Stitzlein, Russell N.	n
Stone, Rebecca M.	n
Stoner, Travis	n
Stover, Michael D.	5 - Synthes
Strasser, Nicholas L.	n
Strnda, Gregory	n
Stronach, Benjamin M.	n
Stryker, Louis S.	n
Stuart, Michael J.	3b – Arthrex, Inc.; 5 – Stryker; 8 – American Journal of Sports Medicine; 9 – AAOS, American Orthopaedic Society for Sports Medicine
Stulberg, Bernard N.	1, 3b – Exactech, Inc.; 2, 5 – Corin U.S.A.; 8 – Journal of Arthroplasty; 9 – Mid-America Orthopaedic Association
Stulberg, S. David	1, 2, 3b – Aesculap/B. Braun; 1 – Biomet, Innomed; 2 – Genzyme; 2, 3b, 4 – Stryker; 2, 3b – Zimmer; 4 – Johnson & Johnson; 7 – Peachtree Publishers
Styron, Joseph F.	n
Sucato, Daniel J.	7 – Saunders/Mosby-Elsevier; 9 – AAOS, Pediatric Orthopaedic Society of North American, Scoliosis Research Society
Sullivan, Jaron P.	n
Sweitzer, Brett A.	n
Swiontkowski, Marc F.	3b – Eli Lilly; 7 – Saunders/Mosby-Elsevier, Wolters Kluwer Health - Lippincott Williams & Wilkins; 8 – Journal of Bone and Joint Surgery-American; 9 – Mid-America Orthopaedic Association
Tabaie, Sean A.	n
Taiber, Andrew	n
Takemoto, Steven	n
Takenaga, Ryan K.	n

Tank, Jason	n
Tatman, Penny J.	n
Taylor, Benjamin C.	5 - Synthes
Taylor, Harold	n
Techy, Fernando	n
Templeman, David C.	1, 3b – Zimmer; 2 – Stryker; 3c – Biomet; 9 – Orthopaedic Trauma Association, SIGN
Teusink, Matthew J.	n
Theiss, Steven M.	2, 3b – Biomet; 2, 3b, 5 – Synthes; 9 – American Spinal Injury Association
Throckmorton, Thomas W.	2, 3b, 5 – Biomet; 3b - Zimmer
Tongue, John R.	n
Torchia, Michael	n
Tornetta, Paul, III	1, 3b – Smith & Nephew; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins; 8 – Journal of Orthopaedic Trauma; 9 – American Orthopaedic Association, Orthopaedic Trauma Association
Tribuzi, Sue	n
Trihas, Deanna	n
Trousdale, Robert T.	1, 3b – DePuy, a Johnson & Johnson Company, MAKO, Wright Medical Technology; 9 – Mid-America Orthopaedic Association
Turchetto, Luigino	n
Turner, Norman S.	9 – Mid-America Orthopaedic Association
Tweedie, Jillian	n
Utz, Christopher J.	n
Vail, Thomas P.	1, 3b – DePuy, a Johnson & Johnson Company; 4 – Pivot Medical; 8 – Journal of Arthroplasty; 9 – American Association of Hip and Knee Surgeons, American Board of Orthopaedic Surgery, Knee Society
Vasileff, W. Kelton	n
Veilliette, Christian	n
Verma, Nikhil N.	1, 3b, 5 – Smith & Nephew; 4 – Omeros; 5 – Arthrex, Inc, Athletico, ConMed Linvatec, Miomed, Mitek; 7 – Vindico Medical-Orthopedics Hyperguide; Arthroscopy; 8 – Journal of Knee Surgery, Arthroscopy, SLACK Incorporated; 9 – American Orthopaedic Society for Sports Medicine, Arthroscopy Association
Vigdorchik, Jonathan M.	n
Vignos, Michael	n
Villalobos, Camilo E.	n
Wagner, Eric R.	n
Walker, Justin A.	n
Wall, Lindley B.	n
Wallace, Maegen	n
Wang, Stewart C.	n
Warlick, Bradley Q.	n
Warren, David K.	3b – 3M Healthcare; 5 – Cubist Pharmaceuticals bioMérieux, Inc.
Watson, J. Tracy	1 – DePuy, a Johnson & Johnson Company; 1, 3b – Smith & Nephew; 2 – Medtronic, Stryker; 3c – Accelalox, Ellipse; 8 – Ortho Knowledge Online; 9 – Orthopaedic Trauma Association
Watson, Kathryn	n
Wechter, John F.	n
Wegryzn, Julien	n
Weiner, Scott D.	5 – Stryker; 9 – American Orthopaedic Association, Musculoskeletal Tumor Society
Wendt, Matthew C.	n
Wera, Glenn D.	n

Westberg, Jerald R.	n
Wetters, Nathan G.	n
White, Richard A.	3b – Biomet; 4 – Amedica, Orthopediatrics; 9 – American Orthopaedic Society for Sports Medicine
Wiater, J. Michael	2, 3b, 5 – Synthes, Zimmer; 3b, 5 – Tornier; 4 – Eleven Blade Solutions, Inc.; 8 – Clinical Orthopaedics and Related Research, Journal of the AAOS, Journal of Bone and Joint Surgery-American, Journal of Shoulder and Elbow Surgery, Saunders/Mosby-Elsevier; 9 – AAOS, American Shoulder and Elbow Surgeons
Will, Ryan E.	n
Williams, Brandon M.	n
Winalski, Carl	4 – GE Healthcare, NitroSci Pharmaceuticals, Pfizer; 5 – Abbott, Genzyme, Johnson & Johnson ATRM, Procter & Gamble, Regeneration Technologies, Inc., Smith & Nephew; 8 – Osteoarthritis and Cartilage
Winder, Richard P.	n
Wingerter, Scott A.	n
Wittig, James C.	n
Wolf, Brian R.	8 – Arthroscopy; 9 – American Orthopaedic Society for Sports Medicine, Arthroscopy Association of North America, Mid-America Orthopaedic Association
Wongsak, Siwadol	n
Wongtriratanachai, Prasit	n
Wood, Meredith	n
Wooten, Clint J.	n
Wuerz, Thomas H.	n
Yaffe, Mark A.	4 - Stryker
Yanke, Adam B.	n
Yeihey, Shaunnah	n
Yoon, Patrick	3b – Arthrex, Inc.; 5 - Synthes
Youssef-Sabry, Fady	n
Yson, Sharon C.	n
Yuan, Brandon J.	n
Zacchilli, Michael A.	n
Zadzilka, Jayson D.	n
Zaltz, Ira	5 – DePuy, a Johnson & Johnson Company
Zhang, Li-Qun	n
Zhang, Qin	n
Zhang, Ting	n
Zimel, Melissa N.	n
Zimmerman, Amy K.	n
Zobitz, Mark E.	n
Zuckerman, Joseph D.	1 – Exactech, Inc.; 4 – Neostem, Joint Innovation Technology; 7 – SLACK Incorporated, Thieme, Wolters Kluwer Health – Lippincott Williams & Wilkins