MID-AMERICA ORTHOPAEDIC ASSOCIATION
31st Annual Meeting
April 17-21, 2013
Omni Amelia Island Resort
Amelia Island, FL

Podium and Poster Abstracts

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

MAOA FIRST PLENARY SESSION
April 18, 2013

1. Long-Term Outcomes of Modified Eden-Lange Tendon Transfer for Symptomatic Trapezius Paralysis from Spinal Accessory Nerve Injury

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PURPOSE: The purpose of this study is to evaluate the outcome of multiple tendon transfers to the scapula to stabilize the scapulothoracic articulation in the treatment of symptomatic trapezius paralysis.

METHODS: Thirteen patients, with average age of 25 years, had a history of trapezius paralysis secondary to spinal accessory nerve injury that failed to recover spontaneously or after nerve repair. The indications for surgery included shoulder pain and weakness and limited range of motion of the shoulder, specifically shoulder abduction. All patients underwent triple tendon transfer, including transfer of the levator scapulae with its bony insertion to the lateral aspect of the spine of the scapula, rhomboid minor with its bony insertion to the spine of the scapula just medial to the levator scapulae insertion, and rhomboid major tendinous insertion to the medial spine of the scapula and superomedial aspect of the infraspinatus fossa. All patients had a CT scan and ultrasound done at brace removal and beyond one year.

RESULTS: At an average follow-up of 25 months (15-35), all patients had improvement of neck asymmetry, restoration of the scapula position compared to the opposite site, and no evidence of winging. All patients had significant improvement of pain from 12 of 13 patients reporting pain as moderate or severe before the operation to 2 of 13 after the operation ($p<0.01$). Improvements in range of motion included active shoulder abduction from average 71^{o} preoperatively to 108^{o} postoperatively ($p<0.02$) and shoulder flexion from average 102^{o} to 140^{o} ($p<0.01$). The aggregate shoulder Constant Score from 41, with a relative score of 49% preoperatively to 63, with a relative score of 70% postoperatively ($p<0.01$). The shoulder subjective value was 44% preoperatively to 67% postoperatively ($p<0.01$). The DASH score improved from 55 to 21 after the operation ($p<0.01$). CT scans demonstrated bony healing; beginning as early as eight weeks postoperatively, while ultrasound demonstrated successful muscle contraction in the line of the transfer. All patients were very satisfied with the outcome of surgery and reported their shoulder as better or significantly better than preoperatively.

CONCLUSIONS: Multiple tendon transfers to the scapula to try to restore the function of the trapezius appear to be effective in stabilizing the scapulothoracic articulation and restoring the function of the trapezius, which in turns lead to significant improvement of pain and shoulder function.

2. Comparative Effectiveness of Prophylactic Antibiotic Choice and Surgical Infection in Arthroplasty

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INTRODUCTION: Prophylactic antibiotics (PA) decrease surgical site infections (SSI). Recent studies have failed to show improved SSI rates with adherence to the Surgical Care Improvement Project (SCIP) measures. The aim of this study is to identify the comparative effectiveness of the SCIP approved antibiotics for SSI prevention.

METHODS: This is a retrospective cohort study using national Veteran's Administration (VA) data on patients undergoing elective primary or revision hip or knee arthroplasty from 2005 to 2009. Data on the type of PA used was merged with VA Surgical Quality Improvement Program data to identify SSI as well as patient and procedure risk factors. Patients were stratified by documented penicillin (PEN) allergy, and SSI rates were compared among patients receiving vancomycin (VANC) alone versus other SCIP-approved PA using chi-square tests. The overall low event rate precluded reliable adjustment for covariates.

RESULTS: A total of 16,568 arthroplasties were included in the cohort. PA use distribution: 81.2% received a 1st generation cephalosporin (CF1), 8.3% VANC, 5.8% VANC + CF1, and 4.7% clindamycin (CLINDA). A documented PEN allergy accounted for 52.9% of patients receiving VANC, and 95.0% of those receiving CLINDA. The overall 30-day observed SSI rate was 1.5%. Unadjusted SSI rates by PA were: 2.6% with VANC alone, 1.5% with VANC + CF1, 1.4% with CF1, and 1.0% with CLINDA. Unadjusted analysis among patients with documented PEN allergy revealed an SSI frequency of 2.1% with VANC prophylaxis compared to 1.0% for CLINDA (Chi-square $p=0.12$). For patients without PEN allergy, SSI rate of 3.3% for VANC prophylaxis compared to 1.6% for VANC + CF1 ($p=0.04$) and 1.4% for CF1 alone ($p<0.001$).

CONCLUSION: Factors other than PEN allergy, such as concern for MRSA or practice style, significantly influence the choice of VANC administration. Higher SSI rates observed with VANC as the sole PA suggest that VANC may not be an optimal PA. These data suggest that CLINDA is more effective in patients with PEN allergy and when there is concern for MRSA, VANC should be used in conjunction with a CF1.

3. Randomized Clinical Trial Comparing Acetabular Cup Insertion: Patient Specific vs. Standard Surgical Instrumentation♦

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INTRODUCTION: Success of total hip arthroplasty (THA) relies largely upon placement of the acetabular cup. Current imaging and preoperative planning are imprecise and unreliable. Severe pathology and less experienced surgeons can give rise to malpositioned cups leading to dislocation, impingement, and increased wear. The purpose of this study was to determine if a three-dimensional software program for preoperative planning combined with Acetabular Positioning System (APS) instrumentation improves placement of acetabular cups compared to standard imaging and surgical instrumentation (STD) in THA.

METHODS: Three fellowship-trained surgeons performed THAs (various approaches) on 36 patients randomized into STD (n=18) or APS (n=18) technique. Preoperative CT scans were obtained on all patients and converted to the 3-D software program. All cases were preoperatively planned; APSs were manufactured for APS surgeries only. For STD cases, the patient's surgery was completed using traditional techniques and instrumentation. All patients received postoperative CT scans to compare the planned to actual results. APS and STD cases were compared using absolute values and deviation from plan in planes of abduction and anteversion.

RESULTS: Mean anteversion for the 18 APS cases was 18.54° ± 7.85°, and mean abduction was 46.4° ± 7.07°. Mean anteversion for the 18 STD cases was 28.44° ± 7.86° and mean abduction was 43.98° ± 9.03°. The differences found between the planned versus actual anteversion were -0.22° ± 6.95° (APS) and -6.89° ± 8.92° (STD). The differences between planned and actual abduction were -1.96° ± 7.28° (APS) and 1.27° ± 9.07° (STD). Difference in the means of anteversion in PSI versus STD was significant (p=0.0176); while differences in means abduction differences were not significant (p=0.246).

CONCLUSIONS: The use of APS instruments resulted in significantly greater anteversion accuracy and precision than STD instruments. Abduction accuracy and precision was similar in each group.

4. Factors Associated with Nonunion in 100 Consecutive Type 2 and Type 3 Odontoid Fractures in Elderly Patients

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SUMMARY: Factors predictive of nonunion in older patients with odontoid fractures include: type 2 odontoid fractures, posteriorly displaced fractures, nonoperative treatment, males, and low-energy mechanisms.

INTRODUCTION: Odontoid fractures are the most common cervical spine injury in older adults and have high rates of morbidity and mortality. The purpose of this study was to determine factors that were predictive of nonunion in odontoid fractures.

METHODS: Between 2002 and 2011, 100 consecutive patients, age 50 years and over, with type 2 and type 3 odontoid fractures were treated at a single Level I trauma center, were followed in a single private practice, and retrospectively evaluated. Radiographs were reviewed and fusion was determined by flexion/extension x-rays, CT scan, or both. Nineteen mortalities were excluded from the fusion analysis.

RESULTS: The overall fusion rate in the 81 patients who were living at their last follow-up was 74.1%. Type 2 odontoid fractures had a fusion rate of 66.1% compared to 92.0% of type 3 odontoid fractures (x^2=0.014). Lower rates of fusion were seen in patients with posteriorly displaced fractures (30/47, 63.8%) than with nondisplaced and anteriorly displaced fractures, (30/34, 88.2%), (x^2=0.047). Patients treated with nonoperative management had a lower rate of fusion (39/59, 66.1%) compared to patients who were treated with surgery (21/22, 95.5%), (x^2=0.007). Males had a lower fusion rate (19 of 32, 59.4%) than females (41 of 49, 83.7%), (x^2=0.015). Patients sustaining a mechanical, low-energy fall had a lower fusion rate (27 of 43, 62.8%) compared to those whose fracture was a result of a high-energy mechanism (33 of 38, 86.8%), (x^2=0.014).

CONCLUSION: Factors predictive of nonunion in older patients with odontoid fractures include: type 2 odontoid fractures, posteriorly displaced fractures, nonoperative treatment, males, and low-energy mechanisms of injury.

5. Predictors of Recurrent Instability Following Acute Patellofemoral Dislocation in Pediatric and Adolescent Patients

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INTRODUCTION: Patellofemoral instability is common in the pediatric and adolescent population, yet prognosis following the first dislocation has been difficult to determine.

METHODS: This was a single institution, IRB approved, retrospective review from 1998 to 2010. The following inclusion criteria were utilized: (1) age 18 years or younger, (2) no prior history of patellofemoral subluxation or dislocation of the affected knee, (3) x-rays within four weeks of the initial instability episode, and (4) a dislocated patella requiring reduction, or convincing history/findings of acute patellar dislocation (effusion/hemarthrosis, medial tenderness, and apprehension). Radiographs were evaluated for trochlear dysplasia using the Dejour classification, and for patella alta using the Caton-Deschamps and Insall-Salvati indices. Skeletal maturity was also assessed.

RESULTS: 222 knees (210 patients), including 120 males (54.1%) and 102 females (45.9%) with an average age of 14.9 years, met inclusion criteria. Twenty-four patients (10.8%) underwent early surgery. All others were initially treated nonoperatively. Of the 198 patients in this group, 76 (38.4%) had recurrent patellofemoral instability, and 39 (51.3%) of these required subsequent surgical treatment. Recurrent instability events were associated with open/closing physes ($p=0.06$), sports-related injuries ($p=0.06$), and trochlear dysplasia ($p<0.01$). Patients with both immature physes and trochlear dysplasia had a recurrence rate of 69% (33/48), with a relative risk of 3.3. Age, gender, BMI, and patella alta were not statistically associated with recurrent instability in this series.

DISCUSSION/CONCLUSION: Conservative treatment for first time patellofemoral dislocation resulted in a 62% success rate. However, skeletally immature patients with trochlear dysplasia had only a 31% success rate with nonoperative management. Nearly half of patients with recurrent instability required surgical intervention to gain stability.

6. Factors Associated with Functional Recovery of Obstetric Brachial Plexus Injuries

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PURPOSE: To evaluate the long-term upper extremity function of patients with obstetric brachial plexus injuries (OBPI) and the factors associated with recovery and future surgeries.

METHODS: This study is part of a review of all patients treated at our institution for OBPIs who are now older than 7 years of age. We excluded any patient who is deceased, has a diagnosis of cerebral palsy, mental retardation, or any central hemiplegia, as well as any patient who has had surgery within two years of the study, since this time period is too short to access functional improvements or limitations from the procedure. We collected data regarding the patient's upper extremity function throughout the early parts of their lives, as well as their birth history, pregnancy, and early life.

RESULTS: We analyzed 101 patients, with average follow-up of 28.6 (+/-24) years. Spontaneous resolution without therapeutic intervention occurred in 23 (23%) of the patients, with complete resolution at 8.9 months of age. The factors associated with no spontaneous resolution involved only maternal or infant conditions. These included gestational or pre-existing diabetes mellitus in the mother (p-value <0.02), maternal hypertension (p-value <0.043), and a birth weight above 10 pounds (p-value <0.004). Interestingly, no obstetric complications or subsequent injuries decreased the risk for spontaneous resolution, including gestation length (p-value <0.69), presence of clavicle fracture (p-value <0.70), shoulder dystocia (p-value <0.59), prolonged labor (p-value <0.13), or infant respiratory distress (p-value <0.23). Furthermore, 15 (65%) that had complete resolution demonstrated an injury limited to Group I (C5-C6) nerve distributions, while only 6 (6%) did not experience spontaneous recovery had Group I injuries (p-value <0.001). The surgeries included nerve reconstruction, neurolysis, tendon transfers, derotational osteotomies, contracture release, and joint fusion. We found that 38 (49%) patients that did not experience spontaneous resolution underwent surgery. The birth factors that increased the patient's risk for surgery included the presence of a clavicle fracture (0.042), shoulder dystocia (0.045), and gestational or pre-existing diabetes mellitus in the patient's mother (0.017).

CONCLUSION: Complete resolution of OBPI is associated with maternal risk factors, however, is not significantly influenced by obstetric complications. When predicting the likelihood of complete recovery, a Group I (C5-C6) injury and birth weight less than ten pounds should be considered. While most of these factors have been shown to increase the risk for the initial injury to occur, to our knowledge we are the first to report on the factors associated with spontaneous resolution.

7. The Development of an Inexpensive and Reproducible Model for Evaluating the Biomechanical Effects of a Discectomy

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(Presented by Jay V. Kalawadia, M.D., Chicago, IL)

INTRODUCTION: Lumbar discectomy is a common surgical procedure. However, removal of disc material can lead to increased degeneration and back pain with long-term follow-up. Currently, there is no cost-effective model for evaluating the biomechanical effects of a discectomy on the lumbar spine.

METHODS: A calf-spine model utilizing the L5/6 disc segment was developed. Soft tissue and the posterior elements were removed. Fourteen specimens, consisting of the L5 vertebral body, the L5/6 intervertebral disc, and the L6 vertebral body, were potted to fit custom jigs. Each segment was tested in flexion-extension, lateral bending, and axial compression in the intact state and after a complete discectomy. The discectomy was preformed by creating 1 cm by 0.5 cm annulotomy and completely removing the nucleus pulposus. Pure rotation moments were applied linearly with a system of cables and pulleys using a Servomotor. A maximum moment of 4.5NM was applied. All rotation tests were performed over ten cycles, and each load was held for one second at the maximum and minimum moment. A similar protocol was used for axial compression with a maximum force of 500N.

RESULTS: There was a statistically significant change ($p=0.00003$) in the total degrees of flexion before and after the discectomy; however, there was no significant change in the amount of lateral bending ($p=0.41$) or in axial compression ($p=0.46$) after the discectomy.

CONCLUSION: A cost-effective and reproducible model for studying the biomechanical consequences of a discectomy is needed. Multiple studies have demonstrated that intact calf spines have similar biomechanical properties to cadaveric human spines, but no reproducible discectomy model has been published. Our calf spine model is inexpensive and reproducible, but the testing protocol needs to be refined. The force applied was sufficient to establish a significant difference in flexion; however, further investigation is needed to determine the correct protocol for lateral bending and axial compression.

8. Decrease in Dislocation After Primary THA with Use of Larger Femoral Heads: An Update on a Previous Series

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BACKGROUND: Our previous study showed that the risk of dislocation after primary THA is higher with the posterior approach and use of smaller femoral head sizes. The purpose of this paper is to report the ten-year update on the cumulative risk of first-time dislocation after THA and to determine whether this risk has decreased over time.

METHODS: From 1969 to 2010, 31,119 primary total hip arthroplasties with varying femoral head sizes were performed at one institution. Patients were routinely followed at defined intervals and were queried specifically about dislocation. The operative approach was anterolateral in 13,739 arthroplasties, posterolateral in 8,996, and transtrochanteric in 8,384. The femoral head diameter was 22-26 mm in 9,828 of the procedures, 28 mm in 12,295, 32 mm in 6,597, 36 mm in 1,991, and 40 mm or greater in 408.

RESULTS: One or more dislocations occurred in 1,059 of the 31,119 hips. The cumulative risk of first-time dislocation decreased at all time intervals from our last series to 1.9% at 1 year, 2.5% at 5 years, 2.9% at 10 years, 3.3% at 20 years, and 3.4% at 30 years. The cumulative 20-year rate of dislocation was 3.3% following anterolateral approaches, 5.4% following posterolateral approaches, and 5.6% following transtrochanteric approaches. The cumulative 20-year rate of dislocation was 10.4% for 22-26 mm heads, 6% for 28 mm heads, and 5.1% for 32 mm heads in hips treated with a posterolateral approach and was 5% for 22-26 mm diameter femoral heads, 2.5% for 28 mm heads, and 3.1% for 32 mm heads in hips treated with an anterolateral approach. The cumulative five-year rate of dislocation for 36 mm heads was 0.7% in hips treated with an anterolateral approach, and 2.0% in hips treated with a posterior approach. Multivariate analysis showed the relative risk of dislocation compared to 22-26 mm heads was 0.66 for 28 mm heads ($p<0.001$), 0.49 for 32 mm heads ($p<0.0001$), 0.32 for 36 mm heads ($p<0.0001$), and 0.08 for heads 40 mm or greater ($p=0.01$).

CONCLUSION: Larger femoral head diameters are associated with a lower long-term cumulative risk of dislocation, and our new data demonstrate that head sizes larger than 32 mm confer an additional protective effect. With the increased use of 32 mm and larger femoral heads since the time of our previous report, the cumulative risk of first-time dislocation has dramatically decreased for all operative approaches, but the effect is greatest on hips performed through the posterolateral approach.

9. Accumulation of Fibrin Affects Fracture Healing in the Murine Model

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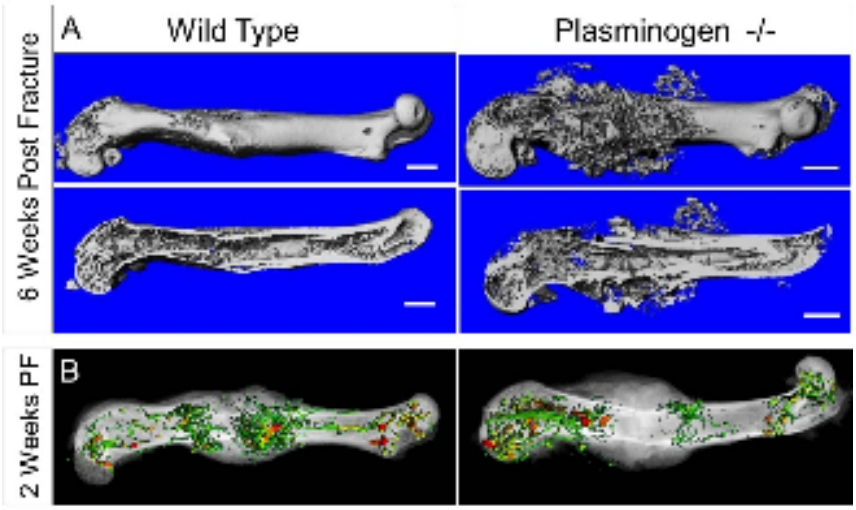
INTRODUCTION: Formation of a fibrin clot is considered to be the initial phase of fracture repair. Hence, many principles of fracture care and pharmaceuticals have been developed to provide a fibrin matrix in the fracture bed thought to represent the initial scaffold of fracture healing. However, recent evidence in chronic diseases such as Alzheimer's, multiple sclerosis, and muscular dystrophy have implicated the accumulation of fibrin as a key molecular component of the pathophysiology of disease. From these studies, we hypothesized that accumulation of fibrin would impair fracture healing.

METHODS: We created a femur fracture on Wild type mice (WT); n=15 plasminogen deficient (Plg-/-) which cannot remove fibrin; n=14, and fibrinogen deficient (Fbg-/-) which cannot make a fibrin clot; n=6. Intramedullary needles were used for fixation. Mice were sacrificed at two and six weeks post-fracture (PF). We injected Antisense oligonucleotide of fibrinogen to Plg (-/-) mice (Plg-/- ASO treated; n=10) to restrict fibrinogen level in blood prior to fracture. Vascularity of the healing fracture was determined by using Microfil, a radio-opaque silicone containing lead chromate, and analyzed with μCT.

RESULTS: X-rays, uCT, and histology revealed that WT and Fbg (-/-) mice formed ossified bridging callus by three weeks PF which was almost completely remodeled and all united by six weeks PF. Plg (-/-) mice failed to develop an organized mineralized callus and failed to unite. Microfil demonstrated that vascularity in the callus was significantly reduced in Plg (-/-) mice as compared to WT or Fbg (-/-) mice (Fig. A & B). ASO treatment in Plg (-/-) mice partially rescued the fracture healing.

CONCLUSION: This study demonstrates that, as opposed to what has been accepted, fibrin is not essential for fracture healing and that accumulation of fibrin can result in delayed, disorganized nonunions. Considering that many conditions which result in pathologic fracture healing such as diabetes, smoking, and aging all have impaired fibrinolysis resulting in fibrin accumulation in tissues, these results may provide valuable insight into novel means of improving fracture healing in these populations by targeting fibrin degradation.



10. Discharge Disposition Following Joint Replacement: Effect of Surgeon Preference

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INTRODUCTION: The cost and quality of care of patients following discharge from the hospital after joint replacement can vary significantly, depending in the location and type of rehabilitation prescribed. Surgeon preference can play a key role. This study examines the relative contribution of surgeon preference and medical co-morbidities on discharge disposition following joint replacement.

METHODS: 3,400 patient discharges following primary joint replacement were extracted from the administrative database of a large healthcare system to examine the discharge disposition of the patients. The impact of several factors were evaluated, including the type of arthroplasty, whether the case was DRG 469 or 470, the type of hospital, the surgeon of record, the case mix index (CMI), and the number of co-morbidities coded among the discharge diagnoses. In addition, the presence of readmission within 30 days was identified. A multivariate analysis was conducted to determine the relative contribution of the identified factors to attempt to create a predictive model.

RESULTS: There was wide variation in the discharge to home rate following primary joint replacement that correlated most strongly with surgeon as the primary variable (ranging from 10% to 82% discharge to home rate). This was followed by hospital (7.3% to 49.9%) and DRG category (45% to 62%). Knees were less likely to be discharged to a home (55%) as compared to hips (70%). Increasing number of co-morbidities contributed to a trend toward lower likelihood of going home, but was not significant, and CMI values were tightly grouped and were not predictive. Patients discharged to home were significantly less likely to be readmitted to a hospital within 30 days (5% vs. 9%). When matching patients by number of co-morbidities, procedure and CMI, the identity of the surgeon was the determinant of whether the patient was discharged to home or a facility.

DISCUSSION: The allocation of scarce resources for an ever-growing population of patients demanding primary joint replacement is a critical issue in an era of dwindling capacity to pay for healthcare. Because the discharge disposition significantly impacts the intensity of resources devoted to patients after joint replacement, physician preference will significantly determine on the downstream cost of caring for this patient population. Significant cost savings opportunities may be available by further understanding this phenomenon.

MAOA BREAKOUT SESSION #1
REVISION ARTHROPLASTY
April 18, 2013

11. Can Lesser Trochanteric Iliopsoas Tenotomies Successfully Treat Intra-Articular Iliopsoas-Labral Impingment?

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BACKGROUND: Currently arthroscopic iliopsoas tenotomies (AITs) are performed at the level of the labrum to treat both painful snapping and impingement of the tendon. However, a recent study found that although this labral-level procedure relieved painful labral impingement, recurrent snapping of the tendon occurred in 60% of the cases. The goal of this study was to determine if arthroscopic tenotomies done at the lesser trochanter would more effectively treat both central labral impingement and snapping of the tendon.

METHODS: From the senior author's database of 880 hip arthroscopies, 30 patients that had AITs at the lesser trochanter to treat, painful snapping of the tendon, and "3 o'clock" labral injuries due to impingement of the tendon were identified. The location of the labral injuries was recorded on each patients "hip sheet" at the time of their hip arthroscopy, and the diagnosis of iliopsoas impingement was confirmed from a review of each patient's intra-operative photographs. All hips were assessed with Byrd's 100-point modified Harris hip scoring system prior to the release and at 3, 6, and 12 or more months after surgery.

RESULTS: Average age of the 30 patients (14 of which were competitive athletes) was 28 years, and their preoperative scores averaged 43 points. After surgery, the patients had hip flexor weakness, used crutches for two to four weeks, and had six-week scores that averaged 77 points. Their scores continued to improve and at 6 and 12 months after surgery, the scores averaged 88 and 90 points, respectively. After an average follow-up of 17 months (range 12-33 months), none of the 30 patients had recurrence of their snapping or pain, and all 14 competitive athletes returned to full participation in their sport which included Division 1-A crew and soccer (she played 90 minutes/game), and high school basketball and softball (she played catcher), at an average of 8.8 months (range 4-12 months) after surgery.

CONCLUSIONS: Arthroscopic ilioposas tenotomies performed at the level of the lesser trochanter appear to be more effective than labral level-tenotomies for alleviating the hip pain of patients that have both central labral impingement and painful snapping of the tendon.

12. The Role of Primary Bearing Type in Revision Total Knee Arthroplasty

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INTRODUCTION: The mobile-bearing (MB) knee was designed to minimize complications of total knee arthroplasty (TKA) while dealing with the kinematic conflict between low-stress articulations and free rotation. While studies have shown that MB and fixed-bearing (FB) prostheses yield equivalent functional outcomes and survivorship, wear patterns and debris types associated with MB knees have been correlated to an increased prevalence of osteolysis. In the present study, the complexity of revision surgery was compared between both designs.

METHODS: 511 patients who received a revision TKA at a single institution between 2000 and 2009 were retrospectively reviewed and separated into two cohorts based on primary surgery implant type: MB (n=114) and FB (n=397). Markers used to determine technical difficulty, which included operative time, use of augmentation and/or bone grafts, intraoperative complications, polyethylene thickness, and level of constraint for each revision implant were recorded.

RESULTS: For failed TKA, there was a significant difference in mean time to revision between MB (54.7 months) and FB (80.6 months) ($p<0.0001$). Subset analysis showed that primary implant lifetimes of FB and MB implants were equivalent if revised within five years of the index procedure ($p=0.67$). In patients revised after five years, mean time to revision was 143.1 months for FB and 109.0 months for MB ($p<0.001$). Subgroup analysis (revisions before and after five years) showed that hinged implants were needed more often in MB revisions ($p=0.003$), which was also a non-significant trend in the overall analysis ($p=0.058$). Overall analysis showed FB implants required more tibial bone grafts ($p=0.027$), which remained consistent in the subgroup analysis ($p=0.048$) for patients revised after five years postoperative.

CONCLUSION: Our data support previous literature that MB prostheses may actually decrease longevity of the implant and further lead to a more complicated revision, requiring increasing amounts of constraint. This study raises concern for use of the MB TKA implants, especially in younger patients who are more likely to require a future revision.

13. Long-Term Outcomes of the Fixed-Bearing TC III Revision Total Knee Arthroplasty

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PURPOSE: To evaluate the survival and functional outcomes at 10 years in the fixed-bearing TC III total knee arthroplasty (TKA) used in revision surgery.

METHODS: We performed a review of patients who underwent a revision TKA with a fixed-bearing TC III implant performed at our institution, with >10 years of follow-up. Our primary outcome was revision surgery. Secondary outcomes included range of motion (ROM), pain, complications, and Knee Society Scores (KSS).

RESULTS: There were 104 knees, with an average follow-up of 12 years. There were 46 men and 58 women, average age of 66 years. Initial surgeries were performed for infection in 17 knees and for aseptic loosening or pain in 72 patients. The average ROM preoperatively was 82.3°, improving to 97.6° postoperatively ($p<0.001$). The pain levels improved, from 30% preoperatively to 81% of patients postoperatively reporting none or mild pain ($p<0.001$). Preoperatively, the average KSS was 52.3 and the functional score was 46.3, while the KSS improved to 83.1 postoperatively ($p<0.001$). At over 10 years of follow-up, only 80% of knees showed no radiographic loosening, while clinically only 3% of knees demonstrated laxity. Ninety-one percent of patients reported their knees to be improved or significantly improved compared to preoperatively. There were 30 postoperative complications. Of the 9 revisions, 6 were for painful instability or aseptic loosening, 2 were periprosthetic fractures resulting in instability, and 1 for infection. The average time to revision was 7.7 years. Kaplan Meier analysis revealed a 5-year survival of 96% and a 10-year survival of 91%. Postoperative pain levels were worsened if over three surgeries in the past ($p<0.03$) and when their preoperative ROM <90° ($p<0.05$). Evidence of radiographic loosening increased in laborers ($p<0.03$), while clinical laxity >5° was increased when preoperative ROM was >90° ($p<0.03$). The only factor that significantly improved postoperative ROM was a preoperative ROM >90° ($p<0.01$). Of note, preoperative infection did not significantly influence outcomes.

CONCLUSION: The fixed platform TC III knee used in revision knee arthroplasty has excellent survival, as well as clinical and radiographic outcomes in the long-term follow-up period.

14. The Patella in Revision Total Knee Arthroplasty

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INTRODUCTION: Although much has been written regarding management of the tibiofemoral articulation in revision total knee arthroplasty (RTKA), there is a paucity of data to guide management of the patella. The purpose of this study is to review our experience with patellar management in RTKA.

METHODS: 422 consecutive RTKAs performed by two surgeons were reviewed. Mean patient age was 65.6 years (range, 35 to 92). Reasons for revision included aseptic loosening (155; 36.7%), deep infection (118; 27.9%), instability (52; 12.3%), stiffness (43; 10.2%), and other (54; 12.8%). Patients were evaluated clinically and radiographically at a minimum of two years.

RESULTS: Management in the 304 aseptic revisions included retention of a well-fixed component in 207 (68.1%), revision using a standard component in 48 (15.7%), resurfacing of a previously unresurfaced patella in 24 (7.9%), patelloplasty in 10 (3.3%), extensor mechanism allograft in 9 (3%), and impaction grafting in 3 (1.0%). Of the 118 two-stage exchanges for infection, a standard polyethylene component was used in 88 (74.6%), patelloplasty in 20 (16.9%), patellectomy in 4 (3.4%), a porous metal component in 2 (1.7%), and patellar osteotomy in 1 (0.9%). A lateral release was required in 33/304 (10.9%) aseptic revisions and 45/118 (38.1%) septic revisions ($p<.0001$). Postoperative complications included patellar maltracking (subluxation or dislocation) in 16 (3.8%; none that required re-operation), 10 ruptures of the extensor mechanism (2.7%), and 3 patellar fractures (0.7%); 3 patellas (0.7%) required repeat revision for aseptic loosening or were radiographically loose. The mean Knee Society score improved from a mean of 51 to 81 ($p<.0001$) at a mean of 42 months (range, 24 to 144).

CONCLUSION: In the majority of RTKAs, a well-fixed patellar component can be retained, and if revision is required, a standard polyethylene component is sufficient in most cases. Complications and re-revisions related to the patellar component are rare.

15. Mid-Term Results for Modular Tapered Femoral Stems for Major Bone Loss in Revision Hip Arthroplasty: A Multi-Center Study

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INTRODUCTION: Revision total hip arthroplasty (rTHA) may involve severe proximal femoral bone loss, bone remodeling, or osteotomies required for implant removal. Tapered, modular femoral stems bypass proximal structural deficiencies and rely on diaphyseal fixation. Potential concerns include subsidence, perforation of femoral cortex, intraoperative fracture, and modular junction failure. We report mid-term results from three institutions for reconstruction of severe femoral bone deficiency (Paprosky 3b and 4) treated with modular, tapered femoral stems.

METHODS: We retrospectively reviewed databases for patients undergoing rTHA between 2002 and 2010 at three independent institutions. Inclusion criteria consisted of Paprosky 3b and 4 femoral bone deficiencies treated with a modular, tapered stem by fellowship-trained arthroplasty surgeons. All cases were reviewed for Harris Hip Scores (HHS), both pre- and postoperatively, complications, and radiographic evaluation. Radiographs were evaluated for subsidence, loosening, osteolysis, or fracture.

RESULTS: After review, 30 patients with Type 3b (n=20) and Type 4 (n=10) defects were identified with a median follow-up of 3.3 years (range, 2-6.6 years). Complete HHS were available for 19 of the 30 patients, and were improved from a median of 57 preoperatively to 81 postoperatively (ranges, 21-79 and 43-100, respectively), ($p<0.001$). Overall implant survival was 90%. Three components (10%) were revised for the following reasons: persistent, chronic infection (n=1), periprosthetic fracture following a ground level fall (n=1), and symptomatic subsidence (n=1). Subsidence occurred in 70% of patients with a median subsidence measuring 2.6 mm (range, 0-9.8 mm).

DISCUSSION: Patients significantly improved following rTHA, despite the need for reconstruction of severe femoral bone deficiency. Radiographic stem subsidence was observed in this multi-center population, with little effect on function or subjective scores. No other device related complications were observed. Modular, tapered stems are an effective means to reconstruct major femoral defects in rTHA.

16. Conversion Total Hip Arthroplasty Following Surgically-Treated Acetabular Fractures

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Conversion THAs (total hip arthroplasty) done in patients with previous surgical treatment of an acetabular fracture can be complex. Inferior clinical outcomes have been reported in THAs following an acetabular fracture as compared to THAs done for non-traumatic indications. Recent advancements in implants and surgical technique have allowed for improvement in the outcome of these patients. The purpose of this study was to evaluate the clinical outcome in a consecutive series of THAs done in patients with surgically managed acetabular fractures at a large trauma center.

MATERIAL AND METHOD: The series included 110 patients who underwent 110 conversion THAs. The mean age at the time of injury was 44 years (15 to 79) with 34% in females and 66% in males. The most common fracture patterns were transverse posterior wall (30%), both column (25%), T-type (15%), and posterior wall (9%). The time from fracture to THA was 48 months (1 to 381) and the average age at the time of THA was 48 years (19 to 80). Clinical outcomes were assessed using the Harris Hip Score in patients with at least two year follow-up.

RESULTS: The mean follow-up was 3.2 years (0.1 to 20.6). Patients with minimum two years of follow-up had an improvement in the Harris Hip Score from a preoperative mean score of 44 (17-68) to a postoperative mean score of 85 (39-100). The series had a 16% revision rate for recurrent dislocation (6%), aseptic loosening (6%), and infection (4%). The patients that required a revision had a mean age of 47 years (20-71) at the time of the conversion THA. These patients were on average two years younger than those patients who did not fail.

CONCLUSION: Our data supports the use of THA as an effective treatment option for these complex patients. Advancements in fracture management and more durable THA options have improved clinical outcomes. Despite these favorable outcomes, the young age and activity level of this patient population must be considered as polyethylene wear and early failure remain a concern in the management of these patients.

17. Use of a Modular Tapered Femoral Stem in the Treatment of an Infected Total Hip Arthroplasty: A 5-Year Follow-Up

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INTRODUCTION: Two-stage exchange arthroplasty has become the gold standard for treating an infected total hip arthroplasty (THA). Reconstructive options can be limited by proximal femoral bone deficiency following resection of the femoral components due to poor bone quality and loss. In order to bypass these defects, modular femoral components can be used. We present the largest cohort of patients treated with a modular femoral component for an infected THA, all with 5 years of follow-up.

METHODS: We retrospectively reviewed all patients who underwent a two-stage reimplantation using a modular, tapered femoral stem for the treatment of an infected THA from 2000-2006. Statistical analysis was performed using paired T-tests and Kaplan-Maier Survival Analysis.

RESULTS: Fifty-four patients underwent a two-stage exchange arthroplasty for the treatment of an infected THA using a Link MP Stem. Of these,16 were lost to follow-up, 4 died, and 5 had their stems removed before 5 years of follow-up leaving 29 patients (12 male,17 female) with an average age of 66 years. Ninety percent (26/29) of patients had at least Paprosky Stage 3A femoral bone deficiency at the time of reimplantation. Ten percent (3/29) of patients had a dislocation, two of which were converted to a constrained liner. One patient underwent revision of the head and neck for symptomatic leg length discrepancies. With removal of the stem as the primary endpoint, the Kaplan-Maier survivorship was 90% at 5 years. Average Harris Hip Score pre-resection was 48.1, at 5-year follow-up it was 78.5 ($p=0.0001$), with a majority of patients having good to excellent results.

DISCUSSION: Use of a modular tapered stem provides stable fixation with significantly improved clinical outcomes in patients following complex two-staged exchange arthroplasty for the treatment of an infected THA.

18. Efficacy of Revision Surgery for Total Hip Arthroplasty Dislocation in the Community

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BACKGROUND: Historically, achieving stability for the unstable total hip arthroplasty (THA) with revision surgery has been achieved in approximately 61% of patients. Multiple techniques to improve stability have been described from isolated head and liner exchange to the use of constrained devices.

PURPOSE: We addressed the following questions: (1) What is the efficacy of revision surgery in a community setting for the unstable/dislocating THA? (2) Does one technique demonstrate clear superiority? (3) Has our efficacy in managing unstable THAs improved over time?

METHODS: We reviewed 6,801 primary THAs performed in our community joint registry over the last 20 years. 111 patients (1.6%; 45 male, 66 female) with a mean age of 69.6 years were revised for instability/dislocation. Failure was defined as a return to the operating room for re-revision surgery for instability. Average length of follow-up was 9.4 years. The frequency of re-revisions was calculated and compared using Pearson's chi-square test. Cumulative re-revision rates were calculated using Kaplan Meier method and types of revision procedures were compared using the log-rank test.

RESULTS: The initial revision procedure was successful in 102 patients (92%). Nine patients returned to the OR for recurrent dislocation following their initial revision surgery. There was no difference between those that were re-revised for instability and those that were not for sex or age. There was no difference in the cumulative re-revision rates by type of revision procedure performed. The incidence of revision surgery for dislocation prior to 2003 was 3.1%, and ≥ 2003 was 0.6% ($p < 0.0001$). Seven of the 66 (11%) patients revised prior to 2003 were re-revised for instability whereas 2 of 45 (4%) patients revised ≥ 2003 were ($p=0.31$). Five of 21 constrained liners were re-revised for varying indications.

CONCLUSION: Revision surgery for the unstable THA is successfully managed in the community with a variety of surgical interventions. Constrained liners should be used with caution. Over time, there was a trend towards improved success of initial revision procedures for instability; however, this was not statistically significant in our series.

19. Revision Total Hip Arthroplasty in Patients 55 Years and Younger

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INTRODUCTION: Patients undergoing primary total hip arthroplasty (THA) are becoming younger and more active, increasing the risk of implant failure and subsequent revision surgery. The purpose of this study is to compare mid-term clinical outcomes, complications, and failure rates for revision and primary THA in patients ≤ 55 years of age.

METHODS: Eighty-seven patients (94 hips) ≤ 55 years of age were identified from a cohort of 569 consecutive hip revision procedures. All patients were followed a minimum four years, until failure, or death. Failures were defined as further operations consisting of exchange or removal of components, including resection arthroplasty. Patients were matched with 94 primary THA hips by age, gender, BMI, hip diagnosis, Charnley classification, and co-morbidities. Clinical outcomes, complications, and failure rates were compared. The groups were followed 6.6 and 6.7 years, respectively.

RESULTS: Twenty-nine hips (30.9%) in the revision group and one hip (1.1%) in the primary group failed ($p<0.0001$). In the remaining 65 revision hips, the average improvement in Harris Hip Score was 19.4, compared to 34.1 after primary THA ($p=0.0005$). There was an average improvement of 1.05 points in the UCLA Activity score after revision, compared to 2.32 points after primary THA ($p<0.005$). Lysis occurred in 16% of the revision cases and 3.4% of the primaries ($p=0.02$). There was no significant difference in loosening between the two groups. Complications occurred in the 26.6% of the revision group, including a 14.9% rate of instability, while 6% of patients in the primary group had postoperative complications ($p=0.0002$).

DISCUSSION AND CONCLUSION: At mid-term follow-up, young patients undergoing revision THA have markedly higher failure rates. Clinical improvement is modest and complication rates are higher when compared to primary THA. These data are important for patient counseling, patient and surgeon expectations, and decision-making regarding primary and revision THA in the young patient population.

20. Radiographically Silent Loosening of the Acetabular Component in Total Hip Arthroplasty

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INTRODUCTION: Osteolysis and component loosening are obstacles to the long-term success of total hip arthroplasty (THA). Radiographic definitions of acetabular component loosening include a concentric lucency at the entire bone-implant interface or the appearance of gross migration or rotation of the acetabular component on imaging. However, without these findings, there is no clear definition of what defines a loose or well-fixed component. In this study, we evaluated the fixation of acetabular components during revision THA and if loosening was detected on plain radiographs or CT.

METHODS: We evaluated all aseptic revision THA performed for osteolysis between 2007 and 2011 at one hospital. We compared the radiologic diagnosis of these patients to their intraoperative findings to determine if any components had loosening that was “radiographically silent”. Radiographically silent loosening (RSL) was defined as loss of fixation which was not or could not be definitively diagnosed utilizing plain radiographs or CT scans.

RESULTS: 137 THA were revised between 2007 and 2011 for diagnosis other than infection. Of the 68 patients who were diagnosed with osteolysis about the acetabular component, all had had a CT scan performed and only one report indicated a possibly loose acetabular component which was confirmed intraoperatively. Of the remaining 67 patients with negative imaging, 9 (13.4%) were found to have a loose cup intraoperatively.

DISCUSSION: Adequate fixation of the acetabular component has not been clearly defined radiographically and no clear algorithm has been determined to assess component fixation. As a result, RSL can go undetected until time of revision arthroplasty as was seen in 9 of 67 patients in our study. Further work is needed to determine the radiographic findings on plain films and CT scans that can help characterize the relative fixation of acetabular components in THA.

21. Correlation of Aspiration Results with the Etiology of Aseptic Failure in Total Hip Arthroplasty

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SUMMARY: Aspiration results and etiology of failure were correlated in patients undergoing revision THA, revealing lymphocyte count >9% and segmented cell count <70% to be 93% sensitive for aseptic loosening.

INTRODUCTION: In the evaluation of patients who have undergone total hip arthroplasty and subsequently develop hip pain, establishing an accurate diagnosis is paramount to the selection of a successful treatment regimen. It is unknown whether inflammatory markers and synovial analysis might differentiate between noninfectious causes of hip pain such as aseptic loosening, component wear, instability, and periprosthetic fracture. A physiological basis exists to suggest that aseptic loosening might be a process of non-segmented leukocytes. The objective of this study was to determine if arthrocentesis differential cell count might aid in the diagnosis of aseptic loosening in patients undergoing revision total hip arthroplasty.

MATERIALS AND METHODS: The charts of all patients who had undergone revision total hip arthroplasty by either of the two senior authors (BRL and SMS) were reviewed. All patients with preoperative or intraoperative aspiration results were included. Data collected included characteristics of the synovial aspirate and operative report. Aseptic loosening was defined as gross intraoperative movement in the absence of infection. From these results, Mann-Whitney U tests were performed, Relative-Operating Characteristic (ROC) curves were created, and sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated.

RESULTS: 134 patients met our inclusion criteria, 54 of whom were classified as having aseptic loosening. A significant difference in differential lymphocyte cell percentage (mean ± standard deviation: 25.3±19.0 vs. 17.6±16.7, $p=0.02$) and segmented cell percentage (49.4±25.9 vs. 63.1±31.3, $p=0.01$) existed between aseptically loose and well-fixed implants respectively. When those implants with a lymphocyte cell percentage of ≥ 9% were considered to be loose, this test had a sensitivity of 83%, a specificity of 38%, a PPV of 47%, and a NPV of 77%. When those implants with a segmented cell percentage of ≤ 70% were considered to be loose, this test had a sensitivity of 78%, a specificity of 58%, a PPV of 55%, and a NPV of 79%. When these tests were combined, i.e., that any implant with a differential segmented cell count percentage of less than 70% or a differential lymphocyte cell count percentage of greater than 9% was considered to be loose, diagnostic accuracy further improved to a sensitivity of 93%, a specificity of 36%, a PPV of 50%, and a NPV of 88%.

CONCLUSIONS: In patients with painful total hip arthroplasties in whom infection has been excluded, aspiration data can be a useful adjunct in the diagnosis of aseptic loosening. In aspirates with either a segmented cell count of less than 70% or a lymphocyte cell count of greater than 9%, the surgeon should consider aseptic loosening; if neither are found, the likelihood of aseptic loosening is less than 12%. While non-specific, aspirate differential can be useful to “rule out” aseptic loosening with a sensitivity well exceeding that of radiographs and paralleling that of bone scintigraphy. Synovial analysis could be considered in patients suspected to have aseptic loosening.

22. Do Multiple Joint Arthroplasties Affect Unilateral Balance Ability Six Months Following Surgery in Total Hip and Knee Arthroplasty Patients?

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INTRODUCTION: To date, little is known about how multiple joint replacement surgeries (TJR) affects static balance. Total joint patients continue to demonstrate side to side differences in loading following surgery and these continued movement limitations could be confounded by a secondary surgery. It is hypothesized that static balance will be decreased in patients following multiple TJR (MULTI) compared to patients recovering from a single surgery (SINGLE).

METHODS: Data from 312 (241 SINGLE, 71 MULTI) patients were included in this study. All of the patients were at least six months removed from the most recent TJR (139 THA, 172 TKA). The MULTI group included any patients with a history of TJR at the knee or hip on either side and excluded all revision TJR patients. Data on single leg stance (SLS) time for all patients was collected during a typical physician visit. The patient was asked to maintain SLS for 10 seconds on each leg. If the patient was unable to accomplish this task, then SLS time for each leg was recorded. Chi-square analysis was utilized to determine if there was a similar ratio of patients who met the 10 second criteria between the groups. Additional analysis in the patients who could not complete the task was conducted to identify if differences existed in stance ability using a two-way ANOVA ($p<0.05$).

RESULTS: Patients following MULTI (50%) exhibited a lower pass rate than following a SINGLE (66%) for 10 second SLS. For the patients who could not meet the 10 second criteria, no difference existed between the MULTI and SINGLE surgery groups and no differences in these groups were apparent between the surgical and non-surgical sides.

CONCLUSION: In general, patients in the MULTI group have poorer static balance. Standardizing a goal for static balance during rehabilitation may facilitate improving these relatively poor functional outcomes which are far below the normative value of 26 seconds for this age group. Normalizing unilateral balance will likely be beneficial in optimizing outcomes following joint replacement surgery due to the relationship of this measure with community ambulation and falls risk.

23. Should Prophylactic Antibiotics Be Withheld Prior to Revision Surgery to Obtain Appropriate Cultures?

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INTRODUCTION: Preoperative antibiotics are known to be critical for decreasing the risk of periprosthetic joint infection (PJI) in primary total hip (THA) and knee arthroplasty (TKA). Antibiotics are oftentimes withheld, however, prior to revision surgery, as there is concern that even a single dose of prophylactic antibiotics may affect operative cultures. The purpose of this prospective randomized trial was to determine the effect of prophylactic antibiotics on cultures obtained at the time of revision.

METHODS: Sixty-five patients with known PJI following 37 TKA and 28 THA at three centers were randomized to receive prophylactic antibiotics either prior to skin incision or after a minimum of three sets of intraoperative cultures. Patients were included if they had a pre-operative culture-positive aspiration and had not taken antibiotics within two weeks of revision. Preoperative and intraoperative cultures were then compared using an equivalence test for proportion differences with a 0.2 margin. Power analysis determined that 54 total patients would be required to determine a proportional difference of 15% between the groups.

RESULTS: Intraoperative cultures were the same in 28 of 34 patients (82%) randomized to receive antibiotics prior to the skin incision compared to 25 of 31 patients (81%) randomized to receive antibiotics after operative cultures (statistical equality, $p=0.0290$). There were 5 cases where intraoperative cultures remained negative although preoperative cultures had grown an organism; 3 in the antibiotics given group and 2 in the antibiotics held group (statistical equality, $p=0.0036$).

CONCLUSION: We found no effect on the results of cultures obtained intraoperatively when prophylactic antibiotics were administered prior to the skin incision. Given the known benefits of prophylactic antibiotics in preventing PJI, preoperative prophylaxis should not be withheld in revision surgery for fear of affecting culture results.

MAOA BREAKOUT SESSION #2
HAND/SHOULDER
April 18, 2013

24. Examining Orthopedic Resident Reductions of Extra-Articular Distal Radius Fractures

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Resident education continues to evolve under the direction of the American Council for Graduate Medical Education (ACGME). Residency programs strive to develop appropriate methods for assessment of the established core competencies. Distal radius fractures are one of the most common fractures treated by orthopedic surgeons and provide an appropriate disease entity to evaluate resident progress. It is plausible that increased experience with distal radius fractures leads to improved reductions. However, it is unclear whether orthopedic resident reductions improve with increased experience and whether this affects the rate of surgical intervention.

PATIENTS AND METHODS: A hospital database identified patients with closed, extra-articular distal radius fractures that underwent closed reduction by a second-year orthopedic resident. Date of reduction was matched to the corresponding day on rotation for the involved resident. Pre- and post-reduction measurements for each fracture included ulnar variance, radial inclination, radial height, and dorsal/palmar angulation. Post-reduction radiographic measurements were compared to resident experience.

RESULTS: There were 28 fractures that met inclusion criteria. There was an improvement in radiographic measurements (radial height, radial inclination, and palmar angulation) over a six-month trauma rotation. Statistical significance was achieved for radial height ($p=0.044$) and radial inclination ($p=0.030$). The majority (71%) of fractures went on to surgical fixation. There was no difference in the length of emergency department visit between the hematoma block and conscious sedation groups.

CONCLUSIONS: Second-year orthopedic resident reductions of distal radius fractures improve by radiographic criteria during a consecutive six-month trauma rotation. However, there is no evidence that resident experience changes the overall probability of subsequent operative intervention.

25. Distal Radius Fractures and the Volar Marginal Fragment: Spring Wire Fixation in Addition to Volar Locked Plating

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BACKGROUND: The volar marginal fragment of a distal radius fracture may not be stabilized with volar locked plating alone due to the small size and distal location of the fragment. The addition of spring wire fixation to volar plating can provide stable internal fixation of this critical fracture fragment without complication from the fixation.

METHODS: A retrospective review (2006-2011) identified nine patients with AO type C distal radius fractures with an associated volar marginal fragment that were treated with volar locked plating and spring wire fixation of the volar marginal fragment. Radiographs, range of motion, and grip strength were measured at the last visit. The Patient-Related Wrist Evaluation (PRWE) was obtained to assess pain and functional difficulties. Complications were also recorded.

RESULTS: All distal radius fractures healed and the volar marginal fragment reduction was maintained with the spring wire fixation and volar locked plating. Mean follow-up was 51 weeks (range, 13-199 weeks). Mean active range of motion was 43° wrist flexion, 51° wrist extension, 75° forearm pronation, and 71° forearm supination. Of those recorded (n=8), the mean grip strength was 21 kg, achieving 66% of the uninjured limb. The average PRWE score was 17. One patient required a carpal tunnel release eight months after distal radius repair. No patient required removal of hardware or had evidence of flexor or extensor tendon irritation.

CONCLUSIONS: The addition of spring wire fixation to volar locked plating provided stable fixation of the volar marginal fragment of distal radius fractures. This technique addresses a limitation of volar locked plating and potentially extends the indications to control the small volar marginal fragment in distal radius fractures otherwise amenable to volar plating.

26. Flexible Insertion and Final Rigid, Locked Intramedullary Fixation for Distal Radius Fractures with a Novel Device

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INTRODUCTION: A novel device that allows flexible insertion and rigid, locked intramedullary (IM) fixation in the treatment of a distal radius fracture can result in satisfactory clinical and radiographic results.

METHODS: A retrospective chart review was performed for all distal radius fractures surgically treated with a novel IM device that allows for flexible insertion and final rigid fixation from June 2010 to July 2011. Clinical outcome measures included pain, range of motion (ROM), grip, and pinch strength. Radiographic outcome measures were fracture union, radial height, volar tilt, and radial inclination.

RESULTS: A total of six consecutive patients (5 females and 1 male) with a mean age of 62 years (range: 42 to 81) underwent IM fixation of the distal radius with a novel IM device. Fractures included AO type 23-A1 (3), AO type 23-A2 (2), and AO type 23-C1 (1). Union occurred in all fractures at a mean of 10 weeks (range: 6 to 20 weeks) from surgery. At a mean follow-up of 17.4 weeks (6 to 41 weeks), no patients complained of pain; mean wrist ROM was flexion to 46° (27° to 60°) and extension to 56° (44° to 65°). Mean grip strength was 20 kg (13 to 35 kg), apposition pinch 5 kg (3 to 6 kg), and opposition pinch 5 kg (4 to 6 kg). The mean volar tilt was 3° (-4° to 10°), radial inclination was 24° (18° to 29°), and radial height was 11 mm (9 to 14 mm). In comparison of immediate postoperative to most recent radiographs, reduction had been maintained in all cases. There was one case of transient paresthesia involving the superficial branch of the radial nerve.

CONCLUSION: A novel IM device that allows flexible insertion and final rigid, locked fixation for select distal radius fractures can result in high rates of fracture union and satisfactory clinical results in this preliminary series.

27. Complications of Volar Plating for Distal Radius Fractures

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INTRODUCTION: The purpose of this study was to evaluate the incidence and characterize the complications of locked volar plating of distal radius fractures

METHODS: A retrospective review of all adult patients with distal radius fractures treated with volar locked plating at a single institution between 2001-2009 was undertaken. Patients treated with additional plating or external fixation of the distal radius were excluded. 596 wrists in 585 patients were included in the analysis. Major complications included: hardware-related problems, tendon rupture or irritation, carpal tunnel syndrome requiring release or compartment syndrome requiring reoperation, DRUJ instability requiring reoperation, major medical complications, post-traumatic arthritis requiring wrist fusion, arterial injuries, and malunion. We identified all other complications as minor complications.

REULTS: The average age was 56.5 years, with a F:M ratio of 3.1:1. Average follow-up was just over 8 months. We identified a total of 85 major and 100 minor complications for a total of 185 complications sustained by 155 patients (26%). Of the 155 patients with complications, 29 had symptomatic hardware removed, 3 had EPL ruptures, and 1 an FPL rupture. Carpal tunnel syndrome requiring surgical intervention was diagnosed in the immediate postoperative period (within the first 3 months of surgery) in 11 patients. One of these required a return to the operating room within 5 days of the index surgery, the rest were observed for a period of weeks or months and eventually returned to the OR on an elective basis.

CONCLUSION/DISCUSSION: At least one major or minor complication occurred in 26% of patients undergoing volar locked plating. The most common of these were sensory disturbances (9.7%) followed by hardware-related problems (6.3%). After hardware removal, carpal tunnel release was the second most common reason for return to the operating room, with all but one of these performed as an elective procedure. The rate of major medical complications, while overall very low, did include one death in the immediate postoperative period as well as one non-fatal massive pulmonary embolism. The overall rate of tendon related problems was also very low (2.0%) with EPL rupture noted in 3 patients, along with a single FPL rupture.

SUMMARY: We found 185 complications in a review of 596 wrists treated with volar locked plating for distal radius fractures at one institution. While volar locked plating is a popular and effective method of distal radius fracture fixation, a significant risk of complications does exist. The majority of these complications were minor sensory neurapraxias which resolved, but painful hardware requiring removal was observed with some frequency.

28. Ulnar Collateral Ligament Strain of the Thumb Metacarpophalangeal Joint: Biomechanical Comparison of Two Postoperative Immobilization Techniques

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HYPOTHESIS: This biomechanical study compares postoperative immobilization techniques of the thumb metacarpophalangeal ulnar collateral ligament. During simulated pinch, we hypothesize the ulnar collateral ligament (UCL) will experience significantly lower strain with transarticular pin fixation and splint application when compared to splint application alone.

METHODS: Twelve cadaveric specimens were used in this study. After isolation of the thumb metacarpophalangeal ulnar collateral ligament, a differential variable reluctance transducer was applied across the proper UCL. After specimen mounting, simulated pinch was achieved through: (1) valgus force application to the distal phalanx and (2) loading the flexor pollicis longus (FPL) tendon. This simulated pinch induced strain in prior biomechanical studies. The metacarpophalangeal joint was held in neutral position with a transarticular Kirschner wire, and a plaster forearm based thumb spica splint was applied. Measurements with a valgus force application to the thumb were performed at 1 and 2 pounds. The FPL tendon was loaded to an equivalent of 2, 4, and 6 pounds of tip pinch force. Displacement measurements were repeated four times. The Kirschner wire was then removed with the splint in place, and the measurements were repeated.

RESULTS: Using the induced strain values from 1 and 2 pounds of valgus force application, average values of 0.015 and 0.026 with pin and splint immobilization were noted, respectively. With splint immobilization alone, strain values were 0.054 and 0.074 with 1 and 2 pounds of valgus force, respectively. The differences between immobilization methods did reach statistical significance with our sample size. With FPL loading, negative strain values were noted. These negative values with pinch force suggest compression across the UCL. A recognized limitation of this cadaveric study is the lack of recruitment of intrinsic hand musculature. With sole recruitment of the FPL tendon, the observed compression of the UCL could be due to paradoxical thumb metacarpophalangeal extension, with the splint acting as a fulcrum.

SUMMARY POINTS

- There are no previous biomechanical studies comparing two commonly used postoperative immobilization techniques after UCL repair.
- With valgus force application, the thumb metacarpophalangeal UCL experiences less strain in the setting of forearm based thumb spica splint and transarticular pin fixation, compared to splinting alone.
- The use of temporary metacarpophalangeal pin fixation may be useful in difficult cases, such as those with volar plate rupture or noncompliance.

29. Treatment of Sagittal Band Incompetence with Splinting

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PURPOSE: This study was designed to evaluate the success of splint treatment for traumatic and atraumatic sagittal band incompetence, and to determine how time from injury or symptom duration relates to the success of non-surgical splint treatment.

METHODS: A retrospective review of all patients with sagittal band incompetence treated with splinting was performed over ten years. All patients had extensor tendon subluxation on physical examination. Patients with open injuries, history of rheumatoid arthritis or connective tissue diseases, and age under 18 were excluded. Ninety-two patients were included: 68 traumatic and 24 atraumatic. Patients were subdivided based on duration of symptoms: acute (<3 weeks), subacute (3-6 weeks), and chronic (>6 weeks).

RESULTS: The long finger was most frequently affected (74%). Patients with atraumatic sagittal band incompetence tended to be older females (age $p<0.03$; gender $p<0.02$). Subluxation resolved with splinting in 77 of 92 patients. If the origin was traumatic, tendon subluxation resolved in 95% (39/41) of acute injuries, 100% (12/12) of subacute injuries, and 67% (10/15) of chronic injures. In atraumatic patients, tendon subluxation resolved in 100% (4/4) of acute patients, 67% (4/6) of subacute patients, 57% (8/14) of chronic patients. Surgery was required in four patients with traumatic injuries (2 acute and 2 chronic), and in four patients with no prior trauma (1 subacute and 3 chronic).

DISCUSSION: We found that splinting is very useful for acute sagittal band injuries, regardless of causation. We found that the usefulness of splinting decreases with chronicity. However, even with chronic subluxation, a large percentage of patients were successfully treated with splinting, avoiding the need for surgical intervention.

30. Cost Analysis for Non-Surgical Treatment of DeQuervain's Tenosynovitis

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INTRODUCTION: This study investigates the success of nonsurgical modalities, the cost of treatment protocols, and the optimal combination of success and lowest cost in treating DeQuervain's tenosynovitis.

METHODS: An IRB approved retrospective study of patients from 2008-2009 at Hand Surgery Specialists was performed. 1,035 patients were provided a new diagnosis of DeQuervain's tenosynovitis. Power analysis determined that 45 patients per group were necessary to show significance. Decision tree analysis evaluated treatment limb cost. Inclusion criteria covered patients with dorsal radial wrist swelling, tenderness over the 1st compartment, and a positive Finkelstein's test. Excluded patients had worker's compensation, inflammatory arthropathy, trauma, or CMC osteoarthritis. The three treatment limbs were as follows: 1 injection only; 1 injection and thumb spica splint (prefab or custom); and 8 therapy sessions and splint (prefab or custom). The endpoint was resolution of symptoms or surgery.

RESULTS: There was no significant demographic difference between treatment limbs (hand dominance nor sex). Showing statistical significance at all levels, injection had a 69% success rate at a cost of $365, injection and splinting had a 56% success rate at a cost of $600, and splinting and therapy had a 78% success rate at a cost of $2,613. A second injection was only 50% effective. When decision tree analysis was used weighting success and cost to determine the cost of treatment, injection alone was the most effective costing at $1,701, injection and splinting cost $2,468, and therapy and splinting cost the most at $3,549.

DISCUSSION: This study's outcomes were similar to literature values. Surgical complication and time off work were not reviewed and could impact final cost significantly. Splinting and therapy had the highest success rate and cost. If a patient failed injection, proceeding to immediate surgery had the lowest cost. Thus, in those cost conscious individuals, injections followed by surgery as necessary is a reasonable option.

31. Contralateral Trapezius Transfer in Patients with Brachial Plexus Injuries to Restore Shoulder Function

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PURPOSE: The purpose of this study is to evaluate the outcome for contralateral trapezius transfer to restore shoulder external rotation in patients with brachial plexus injuries.

METHODS: Nine patients were included in this study. All patients had a history of persistent shoulder paralysis as a result of traumatic brachial plexus that failed to recover spontaneously or after nerve reconstruction. Furthermore, these patients all had compromised ipsilateral lower trapezius muscle either as a result of the original trauma or prior spinal accessory nerve transfer. The indications for surgery included weakness in shoulder external rotation resulting in marked activity limitations, as well as some degree of shoulder pain from instability. On physical examination, all patients had internal rotation contractures with no active external rotation, while most also demonstrated significant loss of shoulder abduction and flexion. Each patient underwent contralateral lower trapezius transfer prolonged with lumbar fascia to the ipsilateral infraspinatus tendon. The shoulder was then immobilized in external rotation with shoulder spica cast for 8 weeks, active assisted range of motion is performed for 6 weeks, progressive strengthening for 8 weeks, and unrestricted activities after 6 months.

RESULTS: At an average follow-up of 23 months, all patients had significant improvement of active shoulder external rotation from no motion preoperatively (which means no ability to move the hand away from the abdominal level) to 20^{o} of external rotation (which means 110^{o} from the abdomen) postoperatively ($p<0.01$). Seven out of 9 patients reported pain levels as moderate or severe preoperatively, while only 1 out of 9 reported moderate or severe pain after surgery ($p<0.01$). The shoulder Constant Score improved from 24, with a relative score of 31% preoperatively, to 55, with a relative score of 60% postoperatively ($p<0.01$). The shoulder subjective value was 15% preoperatively to 45% postoperatively ($p<0.01$). The DASH score improved from 64 to 42 points ($p<0.01$). All patients reported successful retraining of the transferred muscles within the first year after surgery. No patients reported any noticeable difference in function of their non-paralyzed shoulders. All patients were very satisfied with the outcome of surgery and report their shoulder as better or significantly better than preoperatively.

CONCLUSIONS: This study demonstrates contralateral lower trapezius transfer is effective in improving ipsilateral shoulder external rotation. This transfer adds an option for tendon transfer to restore shoulder external rotation when no other ipsilateral muscle is available for transfer.

32. Reverse Total Shoulder Arthroplasty in the Osteoporotic Patient

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Reverse total shoulder replacement continues to gain popularity and has proven to be a highly effective procedure in the treatment of rotator cuff arthropathy. The osteoporotic patient presents a challenge to this procedure since the patient is vulnerable to intraoperative fracture, but glenoid and humeral implant stability may be significantly affected. Elderly patients often have thin cortices and wider intramedullary canals which can compromise humeral stem fit. Additionally, trabecular bone adjacent to the subchondral surface of glenoid is often deficient leading to difficulty with glenoid fixation. This study reports preliminary outcome results of elderly patients undergoing reverse total shoulder replacement. Technique, intraoperative findings, and complications are evaluated. Patient satisfaction survey and functional outcome is also reported. Forty-four patients over the age of 70 undergoing a reverse total shoulder arthroplasty at a single institution by two surgeons with a minimum follow-up of six months were included. The procedure was performed in all cases via the deltopectoral interval. In 29 patients a cemented humeral stem, and in 15 patients a press fit humeral stem was used. Glenoid fixation was press fit and secured with screws in all cases. An autograft humeral head was used to supplement fixation of the glenoid in 29 cases. No intraoperative fractures occurred in 44 patients. Glenoid stability was noted to be acceptable intraoperatively in all patients. There were two patients noted to have instability, which occurred within the initial six months. One was revised, the other treated with further immobilization. No postoperative infections were noted and no thromboembolic events. At final follow-up, all implants were radiographically stable without evidence of osteolysis. Functional outcome was excellent in 39 patients, good in 3 and fair in 2. The reverse total shoulder replacement appears to result in a high likelihood of success in the osteoporotic patient. Implant stability and pain control can be predictably accomplished. Humeral head autograft should be considered if glenoid bone loss is present, and it is recommended to have a cemented stem option available.

33. The Influence of Scapular Neck and Glenoid Anatomy on Impingement-Free Motion in Reverse Shoulder Arthroplasty

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INTRODUCTION: Prosthesis design, scapular anatomy, and operative factors can all contribute to the occurrence of scapular notching after reverse total shoulder arthroplasty (TSA). The purpose of this study was to test the hypothesis that anatomic and prosthetic factors resulting in medialization of the joint line and decreased offset will lead to decreased impingement-free range-of-motion (ROM) following reverse TSA.

METHODS: CT images of two non-pathologic adult scapulae representing long and short scapular neck anatomy were uploaded into 3-D shoulder simulator software to model ROM following reverse TSA. We performed 120 different simulations by varying the anatomic and prosthetic factors in each specimen, and determined the effect of each of these factors on impingement-free ROM during arm adduction and abduction.

RESULTS: The predominant area of bony impingement occurred along the posterior pillar of the scapular neck more commonly than the anterior neck. Statistical analysis demonstrated that inferior positioning, increased tilt, and increased offset of the glenosphere significantly improved impingement-free ROM. Although a long scapular neck demonstrated more impingement-free ROM compared to a short scapular neck, this difference was not significant.

DISCUSSION: Native scapular anatomy was not found to significantly impact impingement-free ROM following reverse TSA, while multiple prosthetic factors significantly decreased bony impingement. In contrast to previously published reports, superior rather than inferior tilt was found to be more beneficial in avoiding impingement. This may be related to increased lateral offset created by increasing tilt. These findings suggest that native anatomic factors that can lead to medialization of the joint line, decreased lateral offset, and potentially increased bony impingement following reverse TSA can be overcome by prosthetic positioning. The ability to preoperatively predict areas of bony impingement may lead to improved implant positioning and ROM as well as decreased scapular notching following reverse TSA.

34. Bone-Preserving Short Uncemented Reverse Shoulder Arthroplasty: Clinical and Radiographic Outcome

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INTRODUCTION: Short uncemented stems have been introduced in an effort to preserve humeral bone stock for possible future revision surgery. However, short stems could be prone to varus or valgus malalignment or failure of fixation, especially when used in the setting of more constrained reverse arthroplasty.

METHODS: A retrospective review was undertaken of 104 shoulders in 98 patients who underwent reverse uncemented shoulder arthroplasty using a short (83 mm) uncemented stem by the two senior authors between June 2008 and May 2011. Eighty-nine standard and 15 lateralized-offset glenosphere components were used. Minimum clinical and radiographic follow-up was one year (average 18 months, range 12-40 months). There were 35 males and 63 females with a mean age of 73 years (range 49 to 92). Surgical indicates included: rotator cuff arthropathy, avascular necrosis, trauma, inflammatory arthropathy, and prior infection.

RESULTS: At most recent follow-up, pain was rated as mild or none in 103 shoulders. Mean motion included active abduction to 141º (59º preoperative) and active external rotation to 45º (preoperative 16º). Modified Neer outcomes were excellent in 59, satisfactory in 43, and unsatisfactory in 2 shoulders. Complications included brachial plexopathy that resolved spontaneously (one patient), and dislocation (one patient). Radiographically, 100 humeral components (96%) were considered well positioned. Adequate ingrowth was consistently observed in all shoulders. Other observations included non-bridging heterotopic ossification in 45 shoulders, proximal humeral stress shielding in 20 shoulders, and tuberosity resorption in 1 shoulder. Heterotopic ossification was not associated with decreased postoperative range of motion. Grade I scapular notching was noted in five shoulders.

CONCLUSIONS: Short uncemented stems achieve adequate implant position and reliable fixation in the setting of primary reverse shoulder arthroplasty. Short-term clinical outcomes demonstrate reliable pain relief and improved shoulder range of motion.

35. The Rotator Cuff Exam: Adding Palpation to Your Diagnostic Armamentarium

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INTRODUCTION: Rotator cuff tears are a frequent source of shoulder pain, and current shoulder physical exam techniques have poor diagnostic accuracy. Transdeltoid palpation of the rotator cuff has been proposed as a simple exam to perform, which does not rely on patient effort and has exceptional accuracy. However, the accuracy of palpation of the cuff as a stand-alone screening exam in patients with shoulder pain has not been performed. The purpose of this study is to define the statistical relevance of cuff palpation in the detection of rotator cuff tears.

METHODS: Sixty-six consecutive patients presenting with shoulder pain were prospectively enrolled. Recorded patient variables included age, gender, BMI, as well as subjective limitations. A standard shoulder examination was performed and included direct palpation of the rotator cuff. Advanced imaging was then performed in selected cases to aid in diagnostic accuracy. Patient data was compared with the presence and degree of rotator cuff tear identified. Statistical methods included chi-square test and analysis of variance.

RESULTS: The crepitance test had a sensitivity of 83% and specificity of 71%, with a positive predictive value of 76% and a negative predictive value of 79% for full thickness and high-grade partial tears. Crepitance was more likely to be found in full-thickness and high-grade partial tears compared to no tear and low-grade tears ($p<0.001$). Increasing age was associated with a cuff tear and improved sensitivity and specificity values ($p<0.001$). No other patient factors revealed an association with a diagnosed cuff tear.

CONCLUSION: Transdeltoid palpation of the rotator cuff is a highly useful stand-alone test in detecting rotator cuff tears. Accuracy improves with combining this examination with increasing age.

36. Failures, Complications, and Re-Operations After Bristow-Latarjet Shoulder Stabilization

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Waqas M. Hussain, M.D.	Cleveland, OH
Morgan H. Jones, M.D.	Cleveland, OH
Julie Y. Bishop, M.D.	Cleveland, OH
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INTRODUCTION: Recurrent anterior shoulder instability is associated with osseous glenoid defects. Failed conservative treatment warrants surgical intervention to reduce or prevent recurrent shoulder dislocation. Isolated soft-tissue reconstruction has a high failure rate. Various methods of bony stabilization, including modifications of Bristow and Latarjet procedures, are considered gold-standard. However, these procedures are associated with unique complications, not without risk of failure and/or re-operation. The purpose of this study was to identify the prevalence of these complications.

MATERIALS AND METHODS: A systematic review of multiple medical databases was performed using specific inclusion and exclusion criteria. Included studies were those reporting outcomes with complication, re-operation, and failure rates following original or modified versions of the Bristow or Latarjet shoulder stabilization surgeries. Levels I-IV evidence were included. Study selection and analysis followed PRISMA guidelines for reporting of systematic reviews.

RESULTS: Forty-five studies were analyzed (1,904 shoulders) (all Level IV evidence). Most subjects were male (82%). The dominant shoulder was the operative shoulder in 64% of cases. Mean subject age was 25.8 years. Mean clinical follow-up was 6.8 years. Ninety percent of surgeries were done open, while 9.3% were all-arthroscopic. Recurrent anterior dislocation and subluxation rate was 2.9% and 5.8%, respectively. Most dislocations occurred within the first year postoperatively (73%). Failure rate (defined as either recurrent instability or revision instability surgery) was 6.7%. Nearly 7% of patients required an unplanned re-operation following surgery. Mean loss of external rotation was 13.0º. The rate of coracoid nonunion or fibrous union was 9.4%. The musculocutaneous nerve was the most common nerve injury reported (less than 1% incidence). Axillary artery pseudoaneurysm requiring repair was reported in five cases.

CONCLUSIONS: Osseous stabilization shoulder surgery using original or modified Bristow and Latarjet procedures has low rates of recurrent dislocation (2.9%), failure (6.7%), and re-operation (7%). Mild loss of external rotation is common. Although rare, complications involving the brachial plexus and axillary artery have been reported with variable success of treatment once recognized.

MAOA BREAKOUT SESSION #3
TRAUMA
April 18, 2013

37. The Effects of Earlier Weightbearing on Surgically Treated Intra-Articular Calcaneus Fractures

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INTRODUCTION: The postoperative management of calcaneus fractures is challenging because of the need to protect the reconstruction from the weight of the patient. Traditionally, patients are left non-weight bearing after surgery for three months, recently more patients have been allowed to weight bear at around nine weeks. This extensive period of limited weight bearing not only delays their return to previous activities (work), but may also negatively impact their final outcome. Delayed weightbearing may cause increased sensitivity, disuse osteoporosis, and dystrophy. The purpose of this study is to examine earlier weightbearing and its associated outcomes. The authors hypothesize that earlier weightbearing does not compromise the reconstruction.

METHODS: An IRB-approved retrospective review of outcomes after open reduction and internal fixation of displaced intra-articular calcaneus fractures between 2007 and 2011 was performed. Outcomes were assessed in relationship to weightbearing status. Radiographs were reviewed to measure Bohler angles preoperatively, postoperatively, and at follow-up visits. Primary outcome measure was the change in Bohler angles from start of weightbearing to final follow-up examination. Return to work and pain levels after surgery were analyzed according to the time of weightbearing as well.

RESULTS: In the group with weightbearing starting at 4-5 weeks after surgery, the average Bohler angles measured in degrees, were 31 (preoperative), 30 (before weightbearing), and 31 (final visit). In the group with weightbearing starting at 6-7 weeks, angles were 25 (preoperative), 24 (before weightbearing), and 25 (final visit). Weightbearing starting at 8-9 weeks, angles were 28, 27, and 27. Patients still had pain at final visit.

DISCUSSION AND CONCLUSION: Bohler angles are stable with earlier weightbearing in patients treated with lateral locking plates. Most patients had chronic pain, and return to work was poor without any statistical significance among the different weightbearing groups. The limitations of this study include the retrospective nature of the study and limited population size.

38. The Biomechanical Strength of Three Constructs for Fixation of Distal Fibula Fractures

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Fixation using lag screws only has been advocated by some authors for stabilization of distal fibula fractures. Although this technique has shown promising clinical results, it has not been compared biomechanically with plate fixation. The purpose of this study was to compare the biomechanical strength of three constructs used for fixation of distal fibula fractures: two lag screws only, a standard lateral one-third tubular plate with one lag screw, and a lateral locking plate with one lag screw. An SER-IV equivalent fracture was created in each of 12 paired cadaver ankle specimens. The deltoid ligament, AITFL, and PITFL were divided, and a long oblique fracture without comminution or bone loss was created at the Weber B level in all specimens. Mean age was 67 years and mean BMD was -0.9. One side in each pair was stabilized with a standard lateral one-third tubular nonlocking plate and one lag screw, and the other side in each pair was stabilized with either two lag screws only or a lateral locking plate and one lag screw. All specimens were then casted with the ankle in neutral. To simulate physiologic loading, an axial load of 800N was applied and displacement was measured. Internal and external rotation torque of 1 Nm was applied and displacement was again measured. Next, cyclic loading of 0-800N in conjunction with 1 Nm of alternating internal and external rotation torque at 1Hz for 10,000 cycles. Finally, an external rotation torque was applied to failure under a constant 800N axial load. No statistically significant differences were seen between fixation constructs for either rotational or axial displacement with cyclic loading, or for either maximal rotational displacement or maximal torque at failure. The locking plate constructs showed a trend towards increased stiffness in the external rotation to failure test, and the lag screw only constructs showed a trend towards decreased stiffness in the external rotation to failure test. These study results suggest that despite this trend, lag screws alone demonstrated considerable resistance to displacement with physiologic loads that mimicked postoperative weightbearing in a cast for simple fractures in non-osteoporotic bone. Further clinical study is warranted.

39. Hypovitaminosis D in a Diverse, Urban Trauma Population

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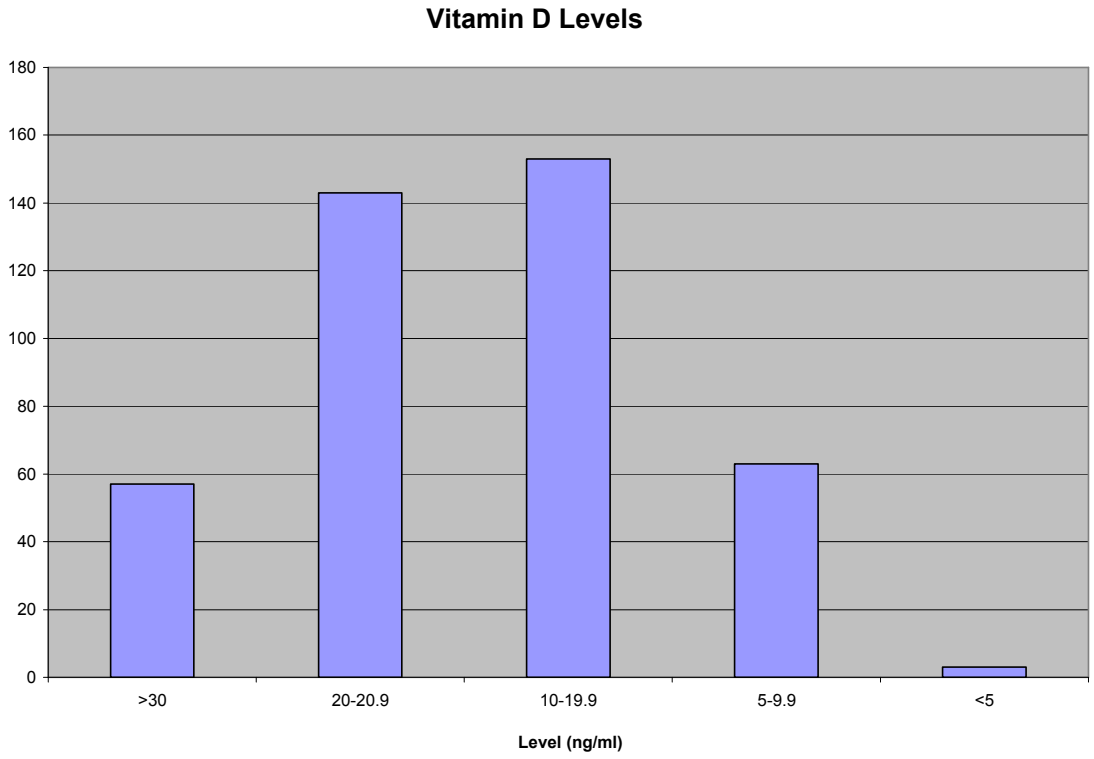
BACKGROUND: Vitamin D is important for fracture healing as well as the maintenance of adequate bone and muscle structure and function. The purpose of this study was to determine the prevalence of hypovitaminosis D in an urban level I trauma center in Houston, TX.

METHODS: We performed a prospective analysis of consecutive patients admitted to the orthopedic surgery service between July 2011 and March 2012 at a Level I hospital. Admission labs included measurement of 25-hydroxyvitamin D levels. The values of normal (>30 ng/ml), insufficient (20-20.9 ng/ml), and deficient (<20 ng/ml) were collected.

RESULTS: 419 patients have been evaluated. 81% were admitted for traumatic injuries and 17% for infection; there was no significant difference between levels in fracture patients versus other injuries (laceration, infection). The average age of the subjects was 41.2 years; there was no significant difference between age categories. 74.9% of the subjects were Hispanic or African American and had significantly lower values of vitamin D. Males (n=285) had an average value of 21.2 ng/ml and female (n=134) 18.6 ng/ml. There were findings of insufficiency in 85%, deficiency in 53%, and levels less than 10 ng/ml were seen in 16%. Seasonal variation was significant, average 23.5ng/ml over the summer months and 16.3ng/ml over the winter months.

CONCLUSION: The prevalence of hypovitaminosis D is widespread. This may negatively affect outcomes for orthopedic patients, but is easily correctable. Thus, Vitamin D serologic analysis is recommended for all orthopedic trauma patients.



40. Do Higher Volumes Result in Better Patient Outcomes for IM Nailing Treatment of Tibia Fractures?

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Wherever complex medical or surgical interventions have been analyzed, improved outcomes are associated with higher volumes. We sought to understand the relationship between surgeon and center volume and patient outcome in the management of tibial shaft fracture using the data from the large international SPRINT trial. Our hypothesis was that higher surgeon and center volume would lead to better patient outcomes, after controlling for injury severity. We evaluated patient outcome according to the primary endpoint (revision surgery to gain union) of the trial as well as the one year functional outcomes as assessed by the Short Form-36 (SF-36) and the Short Musculoskeletal Function Assessment (SMFA) questionnaires.

MATERIALS AND METHODS: The SPRINT trial is a multinational multicenter randomized controlled trial comparing insertion of tibial nails with and without reaming of the canal in both closed and open tibia fractures. 1,339 patients were enrolled between July 2000 to September 2005 in Canada, the United States, and the Netherlands. The inclusion criteria were a closed or open tibial shaft fracture amenable to management with an intramedullary nail in skeletally mature adults. 1,226 (93%) patients completed one-year follow-up. The SPRINT Investigators evaluated an intervention required to gain union of the fracture inclusive of bone grafting, exchange nailing, and dynamization in patients with a fracture gap of less than 1 cm. In patients with closed fractures, the event rate was 11% in the reamed fracture group and 17% in the unreamed fracture group (Relative Risk 0.67 95% CI 0.47 to 0.96, p=0.03). In patients with open fractures, the difference was not statistically significant.

We analyzed the data utilizing the same primary composite outcome looking at the effects of center volume, individual surgeon volume, surgeon experience (resident, fellow, attending), and regional differences by country. Center volume was evaluated in quartiles of the total number of SPRINT patients enrolled. We focused on the primary outcome of reoperation to achieve fracture union as adjudicated by the adjudication committee.

RESULTS: We excluded centers with less than 10 SPRINT patients because of higher variability in the care of these patients and the potential impact on patient outcome. The following is based on 26 centers.

Table : Multivariable Logistic regression: SPRINT primary endpoint is the outcome.

	Odds Ratio	95% CI	p-value
Center Volume			
High vs. Low	1.23	(0.74, 2.03)	0.43
Moderate vs. Low	1.20	(0.73, 1.97)	0.47
Isolated vs. Multitrauma	0.68	(0.45, 1.04)	0.08
Male vs. Female	1.25	(0.77, 2.01)	0.36
Age, 10-year increase	0.92	(0.81, 1.05)	0.20

Hosmer-Lemeshow goodness of fit, p=0.63.

DISCUSSION: Research into complex surgical interventions has generally confirmed the relationship between higher surgeon and center volumes and better patient clinical outcomes. Little prior research has evaluated the impact of volume on functional outcome. We make the following observations based on our analysis of our data:

- Patients treated by a moderate volume surgeon have a lower risk of re-operation (our primary SPRINT endpoint) than those treated by a low volume surgeon.
- Patients with isolated fractures have better quality-of-life at one year than those with multitrauma.
- Older patients have a poorer SMFA Function score at one year than younger patients.
- Patients treated at a moderate volume center have a poorer SMFA Bother score at one year than patients treated at a low volume center.

Improved functional outcome for patients with isolated tibia fracture as compared with multiple trauma confirms prior research regarding the functional outcome of trauma patients. Similarly, better functional outcomes for younger as compared to older patients confirms prior findings on the impact of aging on patient function. As we analyze the impact of center volume on patient clinical (reoperation to achieve fracture union) and functional outcome, we do see a difference between moderate volume centers and lower volume centers and surgeons. However, the relationship does not hold with regard to the highest volume centers/surgeons. There are no geographic effects on the outcomes of patients with tibia fracture.

There are several limitations to these analyses. The division of centers into high, medium, and low volume is based on recruitment of patients into SPRINT which is loosely correlated with overall volumes of tibia fracture patients being treated with tibial nailing. Additionally, other surgical procedure volumes likely impact the quality of the surgery for intramedullary nailing of the tibia. Intramedullary nailing of femoral fractures and overall utilization of intraoperative radiographic imaging for insertion of implants also likely impact the quality of surgical care when inserting an interlocking tibial nail.

Intramedullary nailing is apparently a technique that is easily taught to less experienced surgeons and can be delivered in hospitals with lower tibial fracture volumes with equivalent results. Since the results of improved clinical and functional volumes do not hold when the highest volume surgeons and centers are evaluated, we conclude that the technical aspects of the management of a tibia shaft fracture with intramedullary nailing are easily taught to less experienced surgeons and centers and that for this procedure, there is no significant additional patient benefit in treatment by a higher volume center or surgeon.

1. SPRINT Investigators. Randomized trial of reamed and unreamed intramedullary nailing of tibial shaft fractures. J Bone Joint Surg Am 2008;90:2567-2578.

41. Validation of the OTA Open Fracture Classification with a Limb Threatening Tibia Fractures Prospective Cohort Study

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Michael J. Bosse, M.D.	Charlotte, NC
Ellen J. MacKenzie, Ph.D.	Baltimore, MD

INTRODUCTION: The goal of this study was to use data from a prospective cohort study of severe limb threatening tibia injuries to assess the validity of the OTA Open Fracture Classification (OFC).

METHODS: 347 open tibia fractures (including severe IIIA and all IIIB and IIIC) were retrospectively classified. The main outcome measure was amputation. Among limb salvage patients, the main outcome measure was the Sickness Impact Profile (SIP).

RESULTS: Correlations between the five OFC components were only moderate to low, ranging between 0.05 and 0.53. An increased severity of each OFC component score was significantly associated with amputations: skin, muscle, and arterial X2 $p<0.0001$ for all three; contamination X2 $p=0.0002$; and bone loss X2 $p=0.0052$. The predictive power of each OFC component with respect to amputation, as measured by predictive Area Under the Curve (AUC), was comparable to that of the Gustilo-Anderson classification. AUCs for the five OFC components ranged between 0.55 and 0.76, compared to 0.42-0.71 for the Gustilo classification. Among salvage patients, having the highest level of the muscle, bone loss, and arterial OFC component was associated with a 2.9, 3.8, and 5.8-point increase in disability at two years. A combination criterion of the highest levels of the arterial and bone loss components was developed, which occurred in 23% of this severely injured population. These criteria predicted a 4.5-point increase in disability (95% confidence interval: 0.2,8.7; $p=0.04$).

CONCLUSIONS: There is a need to improve and refine the methodology of open fracture classification to guide injury description and stratification. The new OTA OFC provides a system to classify soft tissue injuries along five clinically significant components. The data shows that these components are not correlated at such a high level as to be considered redundant and are all strongly predictive of amputation, a major clinical outcome. Furthermore, the data suggests several OFC components may be associated with clinically and statistically significant differences in long-term functional outcome.

42. Incidence of Arthroplasty and Secondary Surgeries After Tibial Plateau Fractures

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INTRODUCTION: Anecdotally orthopedic trauma surgeons believe tibial plateau fractures all do fine. The purpose of this study was to review the actual outcomes of patients that sustained tibial plateau fractures and determine the incidence of secondary surgical procedures and total knee arthroplasty.

METHODS: A retrospective review identified tibial plateau fracture patients managed from September 2005 to June 2009 at an ACS level I trauma center. Demographics, co-morbidities, pre-existing arthrosis, fracture type, and initial management data were obtained. A prospective telephone survey was done to determine if they had undergone any other surgical procedures.

RESULTS: 215 patients were identified. 25.5% of these patients had secondary surgical procedures related to their tibial plateau fracture—most commonly meniscus repair and hardware removal. 9/107 (8%) patients contacted by phone underwent total knee arthroplasty. 6/9 (67%) patients had bicondylar plateau fractures. There was one Schatzker 2 (11%), one Schatzker 3 (11%), and one Schatzker 4 (11%). 5/9 (56%) had posteromedial and lateral surgical approaches during their initial operative fixation. The average time from injury to arthroplasty was 24.7 months.

CONCLUSIONS: Despite having primarily high-energy complex tibial plateau fracture types, only 8% of patients progressed to have post-traumatic arthrosis that warranted total knee arthroplasty. The early to mid-term outcomes after open reduction internal fixation in a large number of patients with tibial plateau fractures shows that the incidence of arthroplasty is low.

44. Radiographic Predictors of Screw Cut-Out for Intertrochanteric Fractures Treated with Cephalomedullary Nails

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INTRODUCTION: Screw cut-out of the femoral head is the most common failure mode with implants used for fixation of intertrochanteric hip fractures. Radiographic predictors such as Baumgaertner's tip to apex (TAD) and Parker's ratio method (PRM) for lag screw placement have been proposed to quantify lag screw position within the femoral head. The purpose of this study was to evaluate these radiographic predictors of screw cut-out in the latest generation of cephalomedullary nails.

METHODS: A retrospective chart review of consecutive patients presenting with intertrochanteric fractures between 2008 and 2010 was performed. TAD and PRM ratios were measured on immediate postoperative AP and lateral radiographs for each patient. Single and multiple logistic regressions and T-tests were used for analysis of screw cut-out.

RESULTS: 176 patients were treated with long linear compression cephalomedullary nail during the study period, and 99 had more than 57 days follow-up for inclusion. Mean radiographic follow-up was ten months. Six (6.1%) patients had screw cut-out at 10, 14, 31, 32, 33, and 57 days postoperatively. TAD was not demonstrably associated with increased risk of failure ($p>0.146$). Increased AP ratio was significantly associated with risk of failure ($p<0.003$, OR=1.386 [95%CI=1.125,1.707], non-failures 49.0±7.9%, failures 67.6±5.2%). Increased lateral ratio was significantly associated with risk of failure ($p<0.028$, OR=1.138 [95%CI=1.015,1.275], non-failures 49.7±8.7%, failures 58.2±8.5%). When considered in a multiple logistic regression, only the AP ratio was significantly (and positively) associated with risk of failure ($p=0.004$, OR=1.393 [95%CI=1.112,1.745]) and neither TAD ($p=0.764$) nor lateral ratio ($p=0.710$) were demonstrably associated with risk of failure.

DISCUSSION: Screw cut-out in the most recent generation of cephalomedullary implants does not appear to be as associated with increased TAD as in previous generations of cephalomedullary nails. AP ratio is, of the three, the most helpful measurement in predicting screw cut-out.

45. How High Can You Go? Retrograde Nailing of Proximal Femur Fractures

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OBJECTIVES: There is no data supported recommendations on how proximal is too proximal for RGN. We describe a proximal segment capture ratio (PSCR). It is our premise that a smaller capture ratio represents a very proximal fracture with less nail capture and, thus, will result in a higher rate of malunion/nonunion.

METHODS: At 6 Level I Trauma Centers, skeletally mature patients with femur fractures within the proximal one third of the femur treated with retrograde intramedullary nails were included. To evaluate RGN of proximal fractures, we describe a PSCR. This ratio is determined by the length from the top of nail to fracture location (A) and the distance from the lesser trochanter (LT) to fracture site (B). The PSCR is a ratio of the amount of nail above the lesser trochanter (C).

RESULTS: There were 107 patients with adequate radiographic and clinical follow-up defined as radiographic union and/or full weightbearing. The average tip of nail to fracture measure (A) was 12 cm (range: 2.3-19). The average distance from the LT to fracture site (B) was 8 cm (range: 0.7-12). The average PSCR (C/A) ratio was 0.35 (range: 0.04-0.89). There was no significant difference between PSCR ratio of 0.3 or less and need for secondary procedures or time to full weightbearing ($p>0.05$). The occurrence of malunion was increased with OTA C type fractures and overall time to union was increased ($p<0.05$). The average time to union increased in those fractures with comminution. There were two nonunions and three malunions. Nine patients required secondary procedures.

CONCLUSION: We describe a PSCR to help determine if a cut-off distance could define indications for proximal femoral shaft RGN increased time to union. Fractures with increased comminution, despite an adequate nail capture ratio trended towards varus malreductions and subsequent malunion. In this study, the proximity of the fracture to the LT alone did not affect results. Using those guidelines, retrograde nailing is safe and effective for the treatment of supraisthmal femur fractures.

46. Retrospective Comparison of Short vs. Long Linear Compression Cephalomedullary Nails for the Treatment of Intertrochanteric Fractures

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BACKGROUND: Cephalomedullary nails have been used since 1988 for treatment of intertrochanteric fractures. The fourth generation of cephalomedullary nail is the “linear compression” nail which is available in short or long nail. At our institution, we used primarily short nails prior to 2008, but after a change in trauma staff began using primarily long nails. The purpose of this study was to compare perioperative outcomes and postoperative orthopedic complications of short and long nails.

METHODS: A retrospective chart review of consecutive patients presenting with intertrochanteric fractures between 2006 and 2010 was performed. Patients were excluded if they were not treated with linear compression cephalomedullary nail or had inadequate follow-up.

RESULTS: 310 patients were treated with linear compression cephalomedullary nails during the study period and 206 patients had adequate follow-up. Mean radiographic follow-up was five months. Eighty-eight patients (42.7%) were treated with short nail, and 118 patients (57.3%) were treated with long nail during study period. Demographics were similar between the two groups. Surgical time was shorter in the short nail group (66.9 vs. 83.6 minutes, p=0.001). Fluoroscopy time was shorter in the short nail group (106.1 vs. 141.4 seconds, p=0.001). Estimated blood loss was less in the short nail group (176.4 vs. 214.1 mL, p=0.042). Infection rate was similar between the two groups. There was one implant failure in the short group and one implant failure in the long group (p=0.999). There were six screw cut-outs in the long nail group and none in the short group (p=0.039). There were seven femur fractures in the short nail group and none in the long group (p=0.002).

DISCUSSION: Our results confirm the suspected advantages of short cephalomedullary nails including faster surgery, less blood loss, and less radiation exposure. There were no screw cut-outs in the short nail group, and there were no femur fractures in the long nail group. There were more femoral shaft fractures in short nails, and this is still high despite implant design changes. The higher screw cut-out rate in long nails may be from increased construct rigidity distally being transferred proximally.

47. Locked vs. Unlocked Cephalomedullary Intramedullary Nails in Stable Intertrochanteric Fractures

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INTRODUCTION: Multiple authors have evaluated the biomechanical stability of intertrochanteric fractures. Many surgeons currently use long cephalomedullary nails to fix these fractures. The indications for deploying distal interlocks in these cases have yet to be determined. The objective of this study was to compare the torsional biomechanical properties of stable intertrochanteric femur fractures in a cadaveric bone model using two different distal fixation strategies, an unlocked long cephalomedullary nail versus a dynamically locked nail.

METHODS: A total of 28 samples, 14 matched pairs were randomly assigned to one of two distal fixation treatment groups; a single distal interlock screw placed in the dynamic orientation or no distal fixation. A standard stable two-part intertrochanteric fracture was produced. Specimens were potted and mounted in a double gimbal fixture facilitating unconstrained motion in the sagittal and coronal planes.

Specimens were cyclically loaded for 10 cycles in both internal and external rotation to 3 Nm with a static axial compressive load of 20 N. Torque and displacement data was recorded digitally at a frequency of 25 Hz. Following dynamic testing, samples were loaded in external rotation at a displacement rate of 10º per minute until catastrophic failure or 70º of displacement. For the dynamic nondestructive test, range of motion and internal and external rotation stiffness were calculated. Torsion stiffness, torsion yield, and ultimate torsion magnitude were calculated during the quasi static torque to failure test. In all instances, the mechanism of failure was recorded.

RESULTS: For the nondestructive dynamic test, the samples instrumented with a distal locking screw reported statistically significantly greater internal (1.54 ± 0.81 Nm/º versus 1.08 ± 0.35 Nm/º, p=0.026) and external rotational stiffness (1.42 ± 0.72 Nm/º versus 0.86 ± 0.36 Nm/º, p=0.009). Samples instrumented without distal locking fixation reported more displacement throughout the test. However, these differences were not statistically significant.

For the torque to failure test, samples with locked distal fixation were statistically stiffer and reported statistically less displacement at the yield and peak torque. The yield torque or region where plastic deformation occurred was statically significantly higher in the samples without distal fixation (8.0 ± 5.3 vs. 4.7 ± 2.3 Nm, p=0.03).

CONCLUSION: Our study confirmed that locking an IMN distally increases the stiffness of the nail-femur construct in both internal and external rotation. Most significantly our findings demonstrated that unlocked samples displayed statistically significant higher yield torque while maintaining comparable peak torque as the locked samples. Unlocked samples allowed for 2.5 times greater external rotation stress as locked samples before yielding from elastic to plastic deformation suggesting that femur with a locked distal construct may fracture earlier than one with an unlocked nail.

The clinical implications of this study are numerous. Our biomechanical testing illustrates that an unlocked construct will tolerate more stress before catastrophic failure (periprosthetic

fracture of the femur). Obviously, a construct which provides adequate fixation stability for fracture healing, while at the same time is tolerable of more stress is preferred. Additionally, choosing to not lock an IMN has the added benefit of increasing patient and OR staff safety as well as decreasing our use of health care resources. Consequently, it is our belief that in choosing a distally locked versus unlocked nail in the treatment of a stable intertrochanteric fracture, unlocked is the preferred choice.

48. Mortality After Intertrochanteric Hip Fracture

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BACKGROUND: Intertrochanteric hip fractures are the most frequently operated fracture type and have the highest postoperative mortality rate of all surgically treated fractures. Despite improvements in timely surgical intervention, improved surgical devices, prophylactic antibiotics, early mobilization, anticoagulation, and medical management, some sources report that there has been no improvement in mortality after hip fracture in the past 50 years of surgical treatment. The goal of this study was to determine the current mortality rate and risk factors for mortality.

METHODS: The charts of 505 consecutive patients with operatively-treated intertrochanteric fractures between January 2005 and October 2010 were retrospectively reviewed. The social security death index was queried for each patient and the date of death was determined. A Kaplan Meier survival analysis was performed and plot was created. Risk factors for mortality were studied including gender, age, surgical time, estimated blood loss (EBL), and inability to extubate at the end of surgery.

RESULTS: The average age at the time of hip fracture was 76.8 (± 15.1) years. 332 (65.7%) patients were female, 173 (34.3%) patients were male. Mortality rate at 90 days was 16.6%, at 6 months was 22.4%, and at 12 months was 31.8%. Hazard ratio for an increase in age by 10 years was 1.47 (1.27, 1.69) and was a statistically significant risk factor ($p<0.001$) for increased mortality. Hazard ratio for female gender was 0.61 (0.45, 0.82) which was a statistically significant protective factor ($p<0.001$) for decreased mortality. Surgical time, estimated blood loss, and inability to extubate postoperatively were not statistically significant risk factors for mortality.

DISCUSSION: Mortality rates in this study were comparable to other historical studies and other recently published studies from 2001 to 2009. This suggests that mortality after intertrochanteric fracture has not decreased in recent years despite improvements in surgical devices and medical management. Perioperative factors were not found to affect mortality. Increased age and male gender were predictors of higher mortality.

49. The Effect of Distal Interlock Fixation in Both Fresh and Healed Stable Intertrochanteric Fractures

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SUMMARY: Distal interlock fixation does not provide superior torsional strength compared to unlocked distal fixation with long cephalomedullary intramedullary nail fixation of stable intertrochanteric fractures

INTRODUCTION: Presently, an estimated 250,000 hip fractures occur annually in the United States. Locking a long cephalomedullary intramedullary nail with a stable intertrochanteric fracture increases operative time, instrumentation, the use of fluoroscopy, and remains more technically demanding compared to unlocked distal fixation.

The objective of this study is to evaluate the torsion stiffness of both locked and unlocked distal fixation of long cephalomedullary intramedullary nail constructs using a novel unconstrained loading device in a stable intertrochanteric fracture

METHODS: Five matched pairs of fresh frozen cadaveric femora were used to evaluate the torsion stiffness of samples instrumented with and without distal interlock fixation. Samples were tested in both internal and external rotation (0±3 N*m) for duration of 10 cycles. Each femur was tested without instrumentation (intact femur), with instrumentation and no fracture (healed intertrochanteric fracture), and instrumented femur with an osteotomy creating a stable intertrochanteric fracture (fresh fracture). The osteotomy was created through the greater trochanter and extending to just proximal of the lesser trochanter. A custom double gimbaled fixture mounted in a bi-axial test frame facilitated torsion testing with the ability to simulate in-vivo loading conditions. All specimens were instrumented with a long cephalomedullary nail with a lag screw placed at an optimal apex distance of less than 25 mm. A distal interlock was placed in the dynamic position in one femur and the other femur of the matched pair was left unlocked. A one way repeated measures ANOVA compared external and internal rotation stiffness between treatments.

RESULTS: The mean external (ER) and internal (IR) rotation stiffness for intact femurs without instrumentation (ER: 2.1±0.5, IR: 2.2±0.5 Nm/°) was statistically stiffer ($p<0.05$ for all) compared to fresh fractured locked (ER: 1.1±0.2, IR: 1.1±0.3) and fresh fractured unlocked (ER: 0.9±0.3, IR: 1.0±0.2) samples. Similarly, both healed locked (ER: 2.5±0.2, IR: 2.8±0.1) and healed unlocked (ER: 2.5±0.5, IR: 2.4±0.3) samples reported statistically higher stiffness compared to fresh fractured treatments. There were no statistically significant differences between intact, healed locked, or healed unlocked treatment groups.

DISCUSSION AND CONCLUSIONS: These results suggest that the unlocked distal constructs provide similar torsional strength compared to locked fixation in these models. Due to the increased operative time and increased complexity of inserting locking distal fixation, an unlocked long cephalomedullary nail may provide a viable treatment option for stable intertrochanteric fractures. In a patient immediately postoperative following nail fixation of a stable intertrochanteric fracture (fresh fracture), both treatments (locked and unlocked) had inferior torsional stiffness compared to the intact and healed constructs. This may indicate that early conservative postoperative treatment may be more important than the locked distal fixation.

MAOA BREAKOUT SESSION #4
SPORTS
April 18, 2013

50. Cost-Effectiveness Analysis of ACI: A Comparison of Periosteal Patch vs. Type I/III Collagen Membrane♦

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INTRODUCTION: Autologous chondrocyte implantation (ACI) involves the use of a periosteal patch (ACI-P) as a cover for transplanted chondrocytes. However, this periosteal patch is associated with a significant rate of graft hypertrophy compared to using a type I/III collagen patch (ACI-C). The purpose of this study was to examine the cost-effectiveness of ACI and determine whether ACI-C is more cost-effective than ACI-P.

METHODS: Outcome data and complication rates from patients undergoing ACI (ACI-P and ACI-C) were derived from the best evidence in the literature. Costs were determined by examining the typical patient charges undergoing ACI at a local orthopedic hospital. These costs, outcome data, and complication rates were used to develop a decision-analysis model comparing ACI-P to ACI-C.

RESULTS: The cost per quality adjusted life year ($/QALY) for ACI-P was $9,466 compared to $9,243/QALY for ACI-C. Sensitivity analysis was performed regarding the additional cost of the type I/III collagen patch ($780) in ACI-C as well as the rate of graft hypertrophy following ACI-P (25%). This analysis revealed that the cost of the type I/III collagen patch would have to reach $1,721, or the rate of graft hypertrophy reduced to almost 11%, before ACI-P would become more cost-effective than ACI-C.

DISCUSSION AND CONCLUSION: The cost-effectiveness of ACI has been reported by Minas (1998) to be $6,791/QALY. Converted to 2011 dollars, that would be $9,585/QALY which is almost identical to the values obtained in the present study, with the cost-effectiveness of ACI-P and ACI-C being $9,466/QALY and $9,243/QALY, respectively. This analysis also reveals that while initially more costly than ACI-P; ACI-C is actually more cost-effective. The initial increased costs associated with using a type I/III collagen patch instead of periosteum are eventually recouped by reducing the rate of graft hypertrophy and subsequent revision surgery associated with ACI-P.

51. Infrapatellar Branch of the Saphenous Nerve Block for Knee Arthroscopy

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BACKGROUND: With the rising use of outpatient knee arthroscopy over the past decade, interest in peripheral nerve blocks as an adjunct has increased. Femoral nerve blocks have been effective; however, they carry the inherent risk of postoperative fall due to quadriceps weakness. We studied infrapatellar branch of the saphenous nerve blocks, which have the theoretical sensory benefits of a femoral nerve block, but no associated quadriceps weakness.

METHODS: This prospective, randomized, double-blinded, placebo-controlled trial enrolled 34 patients into each arm, comparing 0.25% bupivacaine block of the infrapatellar branch of the saphenous nerve against placebo for simple knee arthroscopy. Short-term outcome measures included VAS pain scores, mobility and discharge times, opioid usage, subjective adverse effects, and 48-hour anesthesia recovery surveys. Long-term measures included 1 week and 12 week Lysholm knee scores.

RESULTS: No adverse effects or increased quadriceps weakness ($p=1.0$) was observed. Improvement in early VAS pain scores and subjective nausea ($p=.03$) was detected. We also observed improved 12 week Lysholm knee scores when failed blocks were excluded ($p=.04$). No difference in opioid usage, mobility time, 48-hour anesthesia recovery scores, or one week Lysholm knee scores was found.

CONCLUSIONS: While we found no significant downside for infrapatellar branch nerve block for knee arthroscopy, we were also unable to demonstrate benefit beyond improved early pain scores and nausea. Knee arthroscopy is inherently uneventful for the majority of patients, so if an early benefit exists it is likely small. Our most surprising finding was an improvement in 12 week Lysholm knee scores when failed blocks were excluded. While we cannot definitively conclude that these benefits exist, we do feel that they warrant further study.

52. CT and MRI Measurements of Tibial Tubercle to Trochlear Groove Distances (TT-TG) Are Not Equivalent

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INTRODUCTION: TT-TG distance is commonly used for surgical decision-making in patients with patellofemoral malalignment and instability. This measurement has historically been performed utilizing axial CT scans. More recently, MRI has been proposed as an equivalent test for measurement of TT-TG distance. We sought to determine the reliability of TT-TG measurements on both MRI and CT, and to determine whether the measurements can be used interchangeably.

METHODS: All patients diagnosed with patellar instability who had received both CT and MRI of the knee between 2003 and 2011 were included (n=59 knees in 54 patients). Two fellowship-trained musculoskeletal radiologists measured TT-TG for each patient by CT and MRI in a randomized, blinded fashion for a total of 236 measurements. Inter-observer reliability was calculated between radiologists for both imaging modalities and inter-methods reliability was calculated between the two imagining modalities. Results are reported using intra-class correlation coefficients (ICC) and Bland Altman analysis.

RESULTS: The 59 knees had a mean TT-TG distance of 16.9 mm (range: 8.3-25.8) by CT and 14.7 mm (range: 1.5-25.1) by MRI. Eighteen patients (31%) had a TT-TG ≥ 20 mm by CT, and only 9 (15%) had a TT-TG ≥ 20 mm by MRI. Inter-observer reliability between the radiologists was excellent for both CT and MRI (ICC=0.777 and 0.843 respectively). When comparing CT to MRI, however, the ICC was considered only fair for each rater (0.532 and 0.539). Eleven patients (19%) had a TT-TG ≥ 20 mm on CT preoperatively and underwent distal realignment by tibial tubercle osteotomy. In this subgroup, the mean TT-TG on CT was 22.5 mm (range 19.8-25.8) while the mean TT-TG on MRI was only 18.7 mm (range 14.4-22.8).

CONCLUSION: TT-TG distance can be measured with excellent inter-rater reliability on both MRI and CT scans; however, the values derived from these two tests may not be interchangeable. This observation should be taken into consideration when MRI is used for surgical planning since MRI may underestimate TT-TG distance when compared to CT.

53. Does Anterior Cruciate Ligament Reconstruction Alter Natural History? A Systematic Review of Long-Term Outcomes

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SUMMARY: In a systematic review, at a mean of 13.9 years post-injury, ACL-R results in reduced knee instability and improved functional outcomes when compared nonoperative treatment.

BACKGROUND: In select patients, injury to the ACL leads to tibiofemoral instability, decreased functional outcomes, and, degenerative joint disease. It is unknown whether reconstruction alters this progression.

METHODS: This study is a systematic review of long-term (>10 year minimum follow-up) results of operative intra-articular reconstruction and nonoperative management of ACL injuries so as to compare (1) knee stability on physical examination, (2) functional outcomes, and (3) radiographic outcomes. After application of selection criteria, 41 patients groups, 27 reconstructed cohorts (1,585 patients), and 14 non-reconstructed cohorts (716 patients) remained with a mean of a mean of 13.9+/-3.1 years follow-up postoperatively.

RESULTS: At final follow-up, while operative and nonoperative cohorts had no difference in loss of range of motion, more patients in the nonoperative cohort had unstable knees on physical examination as measured with the Lachman test (33.9 vs. 87.0% positivity respectively, $p<0.001$), pivot shift test (26.2% vs. 48.4% positivity respectively, $p<0.001$), and KT1000 arthrometer test (33.0% vs. 56.6% of patients with greater than 3 mm of side-to-side-difference in maximum manual testing respectively, $p<0.001$). Significantly more patients in the non-operative cohort required further surgical intervention upon their knees (13.2% vs. 33.4% respectively, $p<0.001$) and significantly more patients in the nonoperative cohort developed subsequent meniscal injury (11.2% vs. 30.6% respectively, $p<0.001$). Functional outcome, as measured using the Lysholm score (88.7 vs. 81.8, $p=0.007$) and IKDC score (84.1 vs. 73.8, $p=0.02$) was significantly better in the operative cohort. Nonoperative cohorts and operative cohorts had no difference mild radiographic degenerative changes or osteoarthritis ($p>0.05$ for both). Patients in the nonoperative cohort were significantly more likely to have end-stage degenerative joint disease (9.5% vs. 21.8% respectively, $p<0.001$.)

CONCLUSIONS: At a mean of 13.9+/-3.1 years post-injury, patients who undergo ACL reconstruction have reduced tibiofemoral instability and improved functional outcomes when compared with patients who do not undergo reconstruction. Patients status postoperative reconstruction do not have less mild degeneration or osteoarthritis than patients status postoperative nonoperative therapy, although they do have less end-stage degeneration. The initial ligamentous injury may be accompanied by chondral and meniscal damage that initiates an inflammatory cascade concluding in joint degeneration, a process that reconstruction is unable to alter. However, continued instability may contribute to this process and, thus, reconstruction may reduce the development of end-stage arthritis.

54. Supplemental Fixation Using Back-Up Anchors for ACL Reconstructions in the Tibiae with Decreased Bone Mineral Density

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(Presented by Sarath C. Koruprolu, B.S., Providence, RI)

INTRODUCTION: Previous studies have shown successful Anterior Cruciate Ligament (ACL) reconstruction outcomes in patients over the age of 50. Research indicates that bone mineral density (BMD) of the tibia decreases after an ACL rupture. This decreased bone density may be an important factor in revision surgery and in older patients undergoing primary ACL reconstruction. The purpose of this study was to compare ACL fixation with bioabsorbable interference (BIS) screws versus BIS with a supplemental backup suture anchor in low-density cadaver tibiae as a means to potentially identify a superior fixation construct in a population with decreased BMD.

METHODS: Ten matched pairs of fresh frozen human female knee specimens (20 total) were harvested with specimen's age ranging from 40-65. The BMD was determined using a DEXA scanner. The first group had a 4.5 mm suture anchor placed 2 cm distal to the interference screws, utilizing the graft's distal whip-stitched suture ends. The tibiae were oriented in custom fixtures such that the bone tunnel was co-axial with the line of pull, representing a worst-case scenario. Constructs then underwent progressive cyclic. This was followed by a tension to failure test.

RESULTS: The interference screw + suture anchor (Group 1) had a significantly higher yield load (702N versus 517N, $p=0.047$) compared to the interference screw alone (Group 2). However, at densities below 0.60 g/cm^2 there was no difference. Using 445N as a cutoff obtained from historical studies for the force of activities of daily living, Group 2 achieved this strength at a BMD of 0.69 and Group 1 achieved this at a BMD of 0.60 g/cm^2.

CONCLUSION: BIS alone offers an adequate fixation in people with a tibia BMD greater than 0.69 g/cm^2. There appears to be a benefit for supplemental fixation with a suture anchor in patients with a BMD between 0.60 and 0.69 g/cm^2. However, in an ACL revision or in an older patient with an ACL reconstruction where the BMD of the tibia is less than 0.60 g/cm^2, an optimal treatment has yet to be identified.

55. A Translational Method to Assess Tibial Tunnel Volumetric Bone Mineral Density In Vitro and In Vivo

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INTRODUCTION: The purpose of this study is to develop a novel method of tibial tunnel volumetric BMD measurement for in vitro and in vivo purposes and to utilize this technique to provide normative BMD and epidemiologic data for cadaveric specimens, a healthy subject population, and an ACL ruptured patient population.

METHODS: Quantitative computed tomography (qCT) was implemented to develop a technique that evaluates the volumetric BMD (mg/cm3) throughout the region of a standard tibial tunnel in vitro and in vivo. This method was applied to 10 cadaveric specimens (n=20 knees), 10 healthy subjects (n=20 knees), and 25 ACL ruptured patients (n=25 knees). The mean total and segmental (proximal, middle, and distal) tibial tunnel BMD were analyzed. Patient characteristics, knee function scores (Lysholm and IKDC), and activity level scores (Tegner and UCLA) were obtained for living test subjects.

RESULTS: The mean tibial tunnel BMD was 166 ± 31 mg/cm3 (cadaveric specimens), 256 ± 28 mg/cm3 (healthy subjects), and 290 ± 36 mg/cm3 (ACL injured patients). There were significant variations in segmental BMD throughout the region of the tibial tunnel within each study groups (proximal versus middle, proximal versus distal, and middle versus distal segments, $p \leq 0.01$).

CONCLUSION: The method of in vitro and in vivo tibial tunnel volumetric BMD assessment introduced in the current study, combined with the observed normative BMD and epidemiologic data, may facilitate the translation of biomechanical investigations of tibial fixation for ACL reconstructions to a clinically relevant ACL injured population, thus permitting clinical application from biomechanical research.

56. The Inter- and Intra-Rater Reliability of Arthroscopic Measurements of Cartilage Defects in the Knee

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Current treatment algorithms hinge on the size and location of the defect to direct treatment recommendations. Sizing of the cartilage defect has been based off of post debridement arthroscopic sizing. The purpose of this study was to determine if arthroscopic evaluation of chondral defects reliably estimates the true size of a cartilage defect. The experiments were performed on ten fresh cadaveric knee specimens. Four discrete lesions were created in each knee, one in each of the following locations: medial femoral condyle, lateral femoral condyle, trochlea, and patella. In each location, lesions were made of various shapes and sizes. Three orthopedic surgeons participated in this study. The surgeons arthroscopically sized defects on all ten knees (40 defects for each surgeon) with each technique separately, and then repeated the measurements a second time. The repeated measures data were analyzed using a mixed effect linear model. Surgeons consistently undersize lesions and this bias from the true size tends to increase as lesion size increases. By measurement method, use of the 3 mm probe resulted in lesion sizes that were furthest from the true size. The intra-class correlation coefficient (ICC) values show distinct trends by location and method. Intra-observer reliability and inter-observer reliability are generally lower at the patella and worst for the trochlea location. Intra-observer reliability and inter-observer reliability at the medial and lateral femoral condyles was good. Overall, visualization has the lowest correlation of all methods, and there is poor agreement when comparing intra-observer reliability to inter-observer reliability. This study highlights multiple factors that influence the arthroscopic estimation of defect size: lesion location, measurement tool, surgeon, and defect size itself. Further, this study indicates that intra- and inter-rater reliability is fair to good, dependent upon location and method of measurement. Surgeons consistently underestimated defect size, and the underestimation if not accounted for can bias treatment. Based on this study, prospective studies should use one of these two tools for measuring defects of a tool.

57. Epidemiology of Meniscal Injuries in U.S. High School Athletes♦

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With the number of high school students participating in athletics continually increasing over the past decade (NFHS), there is increased need for identifying and monitoring injury patterns in order to implement evidence-based prevention interventions. However, data on meniscal injuries specifically in children are likely outdated or lack generalizability. Although some publications report meniscal injury incidence by sport, these studies lack athletic exposure information and, thus, cannot calculate risk ratios among sports or gender. The purpose of this study was to describe the epidemiology of meniscal injuries in high school athletes. Data was collected using the National High School Sports-Related Injury Surveillance System, High School RIO (Reporting Information Online), an Internet-based sports injury surveillance system. Athlete exposure (AE) was defined as one athlete's participation in a practice or competition. Athlete exposure was reported as the sum of the number of athletes participating in each practice and in each competition every week. The overall rate of injury per 100,000 AEs was higher in competition (14.1) than practice (3.3) (RR=4.3; 95% CI, 3.6-5.0). Although competition to practice RRs were equivalent for boys and girls overall (4.3 and 4.4?, respectively), the injury rate per 100,000 AEs was higher for boys than girls (6.9 and 4.9, respectively, RR=1.44; 95% CI, 1.22-1.71). This trend was reversed when looking exclusively at the gender-comparable sports of soccer, basketball, track and field, lacrosse, and baseball/softball. The injury rate per 100,000 AEs in gender-comparable sports was higher for girls than boys (5.8 and 2.7, respectively, RR=2.07; 95% CI, 1.61-2.66). This study, the most comprehensive study of meniscal injuries in high school athletes known to date, found that meniscal injuries differed by sport, gender, mechanism of injury, and exposure (competition versus practice).

58. Return to Sports After Surgical Treatment of Meniscus Tears in the Pediatric and Adolescent Population

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INTRODUCTION: Meniscus injuries in the young athlete present a therapeutic challenge for orthopedic surgeons. Given the increased healing potential for meniscus tears in these patients and the higher potential for arthritis after meniscectomy, efforts are often made to repair these tears. However, this is not always possible. Several factors, such as patient demographics, motivation, injury characteristics, surgical treatments, and post-surgical rehabilitation choices may influence patient outcomes and return to activity. This study aims to identify these factors, and how they contribute to returning to sports.

METHODS: All the patients of two orthopedic surgeons at one institution who underwent meniscus surgery at age 18 and under were identified and contacted via either telephone or mail. Informed consent was obtained, and the patients (or legal guardian) were provided with a novel Return to Sports Questionnaire and the Marx Sports Activity Scale.

RESULTS: A total of 67 patients were surveyed, 29 male and 38 female. Average age at surgery was 16 years and at time of survey was 19 years, with an average follow-up interval of 3.3 years. Surgeons performed 34 meniscus repairs (MR), including 24 with concurrent anterior cruciate ligament reconstructions (ACLR), and 41 meniscectomies (MY), including 19 with ACLR. Eight patients underwent MY and MR in the same knee, including 7 with ACLR. Patients who underwent MY took longer to return to their desired level of sport than after MR or combined MY/MR, and more often did not return to that level at all. The highest percentage of patients from all groups took over one year to return to their desired level of sports activity. On average, patients who desired to return to collegiate level sports took the longest, and those who described themselves as extremely motivated returned the fastest. The average Marx Sports Activity Scale score was 10.5, with no significant differences between the surgical groups.

CONCLUSIONS: Return to sports after meniscus surgery in the young athlete is affected by a multitude of factors, including injury type, motivation to return, and desired level of activity.

59. The Value of an On-Field Physical Examination Used in Conjunction with a Survey vs. Survey Alone for Identifying Youth Pitchers with Arm Pain

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OBJECTIVE: The AOSSM is currently investigating the national prevalence of arm injury in youth baseball pitchers through the utilization of an on-field survey. While this survey uses time-loss as a means of identifying these players, it is believed that this may be neglecting a large portion of injury players. This study evaluates the effectiveness of this on-field survey. It is hypothesized that a standalone survey is unlikely to give a complete picture and that an additional physical examination is necessary to identify all injuries.

METHODS: Players ages 9-18 on all city-sponsored and high school teams in the area who had pitched in the last 12 months completed the on-field survey. The teams were then divided into two groups. One group was examined only if a time-loss injury was reported. The other was examined if they had any current complaints of pain, even without a time-loss injury.

RESULTS: An overall injury rate of 37.6% was found for all 77 players. This included all players regardless of time-loss history. A rate of 56.3% of pitchers with a positive time-loss injury history were found to have a positive examination, while 90.9% of pitchers with a negative time-loss injury, but positive complaint of pain were found to have a positive examination. The most common complaint in both groups was elbow tenderness with the most common location being the medial epicondyle.

CONCLUSION: While the on-field survey is effective at identifying time-loss injuries, it may neglect more mild injuries, leading to underestimated injury rates. The high frequency of positive examination findings in athletes with negative time-loss injury exemplifies the importance of physical examination. This study suggests the use of a physical examination in addition to on-field survey to accurately identify injured players.

60. The Epidemiology of Single Season Musculoskeletal Injuries in Professional Baseball

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INTRODUCTION: The first game of organized baseball started in1846 and has been a "national pastime" in the United States. Although considerable amount of research has been devoted to the study of biomechanics and the treatment of baseball-related injuries, there is paucity of data that describes the epidemiology of Major League Baseball (MLB) injuries. The purpose of this study is to evaluate the injury pattern, incidence, and type as a function of position with associated days missed in one professional baseball organization (major and minor league players) for one complete season.

METHODS: We analyzed the disabled and injury list of one single professional baseball organization for the season of 2010 to 2011. This included players of both the major and all associated minor league organizations. We reviewed all of the injuries and the number of total days missed secondary to each injury. All of the injuries were categorized into major anatomic zones that included: shoulder, elbow, wrist/hand, back, abdominal/groin, hip, knee, and ankle/foot. The data was further stratified based on the injury type and the number of days missed due to that particular injury. Statistical analysis was performed on all data.

RESULTS: In pitchers, elbow injuries in 12 players resulted in 466 days missed, and ankle injuries were seen in only 2 players with 0 days missed. In catchers, wrist injuries in 4 players resulted in 89 days misses. In position players, 16 players had abdominal/groin injuries that resulted in 318 days missed and 9 players with shoulder injuries that resulted in a total of 527 days missed. Overall, 134 players were injured and a total of 3,209 days were missed. Pitchers had 27 times and 34 times the rate of days missed due to elbow injuries compared to positional players and all players, respectively. Abdominal and groin injuries caused the pitchers to have 5.6 times and 6.4 times the rate of days missed than the position and all players, respectively. Pitchers and catchers had 16.8 times and 22.6 times the rate of days missed due to knee injuries compared to the position players, respectively. Abdominal/groin injuries resulted in the most number of recurrences in position players (n=5).

CONCLUSION: Both elbow and abdominal/groin injuries are the most disabling injury pattern seen in pitchers. In the position players, shoulder injuries resulted in the most days missed. Knee injuries resulted in the highest rate of days missed in both pitchers and catchers. Although abdominal and groin injuries are more common in positional players, it resulted in the highest rate of days missed in pitchers.

61. Association of Pain with Overhead Throwing and Upper Extremity Range of Motion and Strength in Collegiate Baseball Players

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INTRODUCTION: Upper extremity range of motion has been shown to be related to injury risk and performance in overhead throwing athletes. It is necessary to understand the roles of upper extremity range of motion, muscle strength, and throwing velocity to identifying risks.

PURPOSE: The purpose of this investigation was to explore the relationship between upper extremity pain, current throwing velocity, shoulder and elbow range of motion (ROM), and upper extremity strength in baseball players. Descriptive cross sectional study. Level of Evidence: 2.

METHODS: Twenty-seven NCAA Division II college baseball players (age=19.96+1.4 years) completed an injury surveillance survey detailing past and present upper extremity injuries and/or pain. Bilateral shoulder and elbow range of motion (ROM) and strength were measured. Throwing velocity in the dominant arm was measured after warm-up.

RESULTS: Dominant to non-dominant arm ROM measurements were significantly different in forward elevation (P=.02), abduction (P=.0007), internal rotation in adduction (P<.0001), internal rotation in abduction (P=0.009), and total ROM in abduction (P=.03). Dominant to non-dominant strength with shoulder external and internal rotation was significantly different (P=.0005). Pain with overhead throwing was noted in 11 of 27 athletes. There were no significant differences in strength or throwing velocity between athletes with pain and those without pain. Wilcoxon-Mann-Whitney univariate analysis revealed elbow ROM as a factor associated with pain (p=.007). Logistic regression analysis showed the odds of experiencing pain with overhead throwing are 17% higher for every one degree decrease in total elbow ROM.

CONCLUSION: Decreases in shoulder ROM and strength were not related to pain in the shoulder of the dominant arm of baseball players. Total elbow ROM appeared to be closely related to upper extremity pain in the overhead throwing athlete. Elbow ROM is a factor associated with pain with overhead throwing and should be investigated longitudinally.

62. The Effect of Oxygen Tension, Hydrogel Suspension, and Rubber-Derived Polymer Seeding on Bioengineered Human Cartilage Implants

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INTRODUCTION: Articular cartilage has a limited capacity to heal, and surgical treatments often fail to reproduce the normal structure and function of hyaline articular cartilage. A non-allograft mature human hyaline cartilage tissue implant currently does not exist. This is a preliminary report of this type of implant utilizing human chondrocytes and an electrospun thermoplastic polyisobutylene-based elastomer (Arbomatrix).

METHODS: Human articular cartilage was obtained during total knee arthroplasty. The chondrocytes were isolated from the chondral tissue though enzymatic digestion. The cells were re-suspended in a protein-based hydrogel embedded upon the electrospun Arbomatrix mats or a plastic surface. The cell/elastomer constructs were then cultured with media changes daily at a variable oxygen tension. The constructs were then divided for gross, histological, and immunohistochemical analysis.

RESULTS: Viable human chondrocytes were found throughout the hydrogel on the surface of the Arbomatrix scaffold. The hydrogel embedded cells maintained the morphological characteristics of chondrocytes. Immunofluorescent staining demonstrated ample collagen II production consistent with hyaline cartilage producing chondrocytes. Lower oxygen tension of the cell culture environment enhanced cellular proliferation and maintenance of phenotype in all groups.

CONCLUSION: While human articular chondrocytes were successfully cultured in a hydrogel on the Arbomatrix polymer scaffold, the extreme hydrophobic properties of the polymer did not appear to be advantageous for chondrocyte proliferation. Both the low oxygen tension of the cell culture environment and three dimensional arrangement of the hydrogel enhanced cellular proliferation and maintenance of phenotype when compared to the monolayer control. Future research will be directed towards the development of an autogeneic or allogeneic chondrocyte-hydrogel implant engineered at a low oxygen tension for human application in the surgical management of articular cartilage injury.

MAOA BREAKOUT SESSION #5
HIP ARTHROPLASTY
April 18, 2013

63. The Impact of Hip Arthroplasty Type on Proprioception

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(Presented by James A. Keeney, M.D., St. Louis, MO)

INTRODUCTION: Improvement in proprioception has been proposed as a potential advantage of surface replacement arthroplasty (SRA) over total hip arthroplasty (THA), but objective proof is lacking. The purpose of this study was to apply recently available advanced technology to determine whether SRA patients have better proprioception compared to similar THA patients.

METHODS: A commercially available device was utilized to quantify dynamic postural control (proprioception). This powered platform quantifies balance by measuring center of mass deviations in six planes: lateral, up/down, anterior/posterior, rotation, flexion/extension, and lateral flexion. The position of a transmitter placed at the lumbosacral junction is recorded every ¼ second. Testing consisted of a learning module, three one-minute tests under double-limb conditions, and three one-minute tests with each single-limb stance. Imbedded software provides a dynamic motion analysis (DMA) score, reflecting the ability to maintain the center of mass, with lower scores indicating improved proprioception. Four groups were studied: healthy controls (n=25), SRA (n=25), standard THA (head size ≤ 32 mm, n=23), and large head THA (head size ≥ 36 mm, n= 21). Dominant leg was recorded for each subject. Patients were asymptomatic (average Harris Hip Score 98), well-functioning (UCLA Score 8), and 1 to 5 years postoperative.

RESULTS: Double leg DMA scores for all groups were similar and showed no difference ($p=0.345$). With single leg testing, there was no difference between the dominant and non-dominant leg in the control group ($p=0.382$). With single leg testing of the operative limb, the SRA group performed better than all THA patients ($p=0.038$), but not better than large head THA ($p=0.182$).

CONCLUSION: SRA appears to result in improved proprioception when measured by the most advanced objective dynamic stability testing available. This seems to be a result of head size rather than the SRA procedure itself, since a significant improvement was not present for SRA compared to large head THA.

64. THA with HCLPE in Patients Less Than 50: 10-Year Follow-Up

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BACKGROUND: Highly cross-linked polyethylene (HCLPE) for use in total hip arthroplasty (THA) was introduced approximately 15 years ago and has become widely used. Superior in vitro wear rates and short-term in vivo wear rates have demonstrated the potential benefits of this new material hopefully improving implant durability. This study seeks to evaluate the relatively (>10 year) long-term radiographic and clinical outcomes of highly cross-linked polyethylene in a subset of patients under the age of 50, who may be more active and, thus, place more demand on the implant materials.

METHODS: Fifty-seven THAs (50 patients) under the age of 50 underwent primary THA at our institution, with at least 10 year radiographic follow-up. All cases used uncemented cup and stems. Initial, mid-term, and most recent radiographs were analyzed using a validated radiographic technique to measure wear. In addition, clinical outcomes were assessed using a validated scoring tool (Harris Hip Score) at each interval.

RESULTS: Average radiographic follow-up was 10.47 years. Mean femoral head penetration at final follow-up was 0.21 mm (95% confidence interval ±0.049 mm). Steady state femoral head penetration was 0.020 mm/year (95% confidence interval ±0.0047 mm/year) at final follow-up. Mean cup inclination angle was 45.1°. There was no evidence of osteolysis, and no patients underwent reoperation for aseptic loosening.

CONCLUSIONS: HCLPE appears to wear extremely well at 10 years in people less than 50. This study supports previous findings and demonstrates that wear continues to be slow at relative long-term follow-up of 10.5 years, even in young patients.

65. Total Hip Arthroplasty in Young Patients: Comparison of Three Bearing Surfaces

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INTRODUCTION: Optimal bearing surfaces used for total hip arthroplasty in the young patient continues to be debated, and the recent problems with hard on hard bearings underscores the importance of this topic. The purpose of this study is to compare primary total hip arthroplasty outcome scores, wear analysis, and revision rates in three consecutive longitudinal cohorts of young patients undergoing total hip replacement with distinct bearing surface combinations.

METHODS: Three consecutive, prospective, longitudinal patient cohorts comprise this study. All patients were 50 years or less at the time of THA. The cohorts include: (1) CoCr on conventional polyethylene (132 THAs in 110 patients, average age was 40.6 and BMI was 28.5), (2) CoCr on HCLPE (70 THAs in 65 patients, average age 39.3 and BMI 29.7), and (3) alumina ceramic on HCLPE group (161 THAs in 148 patients, with average age 38.1 and BMI 29.1). Hip function was determined with the Harris Hip (HHS) and UCLA scores. Mean linear polyethylene wear was measured by the Martell edge detection method (Hip Analysis Suite, version 8.0.1.7).

RESULTS: HHS in the CoCr/conventional group improved from 51.1 to 87 at average of 68.5 months and UCLA from median 3 to 5. HHS in the CoCr/HCLPE group improved from 43.2 to 84.2 at average 69 months and UCLA median increased from 3 to 6. HHS improved in the ceramic/HCLPE group from 48.0 to 84.1 at average 50.5 months and UCLA improved from a median of 4 to 6. The clinical improvements in the three groups were not different. The mean linear wear rates were 0.11 mm/year for CoCr/Conv, 0.01 mm/year for CoCr on HCLPE, and 0.04 mm/year for ceramic with HCLPE. There were two revisions for aseptic loosening in the CoCr on HCLPE group, one in the alumina ceramic group and one in the CoCr on conventional polyethylene group.

DISCUSSION AND CONCLUSION: In the young THA patient population, highly cross-linked polyethylene is associated with major reduction in wear and no catastrophic failure. Continued follow-up of these groups is needed to determine long-term polyethylene performance and implant survivorship.

66. Minimum 35-Year Follow-Up of Charnley Total Hip Arthroplasty in Patients Less Than 50-Years-Old

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INTRODUCTION: The purpose of the present study was to evaluate the clinical, radiographic, and functional outcomes of Charnley total hip arthroplasty in patients under age 50 (a group that continues to actively function with their THA) at minimum 35 years of follow-up.

METHODS: A consecutive non-selected cohort of patients who were under 50 years of age at index Charnley total hip arthroplasty has been prospectively followed. The original cohort consisted of 93 total hip arthroplasties performed in 69 patients. This cohort was previously evaluated at 25 year follow-up, allowing for a longitudinal comparison of patient function over time. For the present study, patients were followed for a minimum of 35 years after surgery or until death. Thirty of 32 living patients were available for evaluation. Radiographic and clinical follow-up with quality of life and hip scores (SF-36, WOMAC, Harris Hip Scores), in addition to functional evaluation with activity scores (UCLA and Tegner), and activity measurements (6-minute walk and pedometer monitoring) were performed.

RESULTS: At the time of most recent follow-up, 32 (34.4%) of 93 total hip replacements had been revised or removed. Twenty acetabular and seven femoral components were revised secondary to aseptic loosening. Since the last follow-up, the average 6-minute walk distance decreased from 1,182 feet to 531 feet. WOMAC and Harris Hip ratings have also significantly declined ($p<0.05$).

DISCUSSION AND CONCLUSION: This study demonstrates the durability of cemented total hip replacements in a young patient population. Although 66% percent of the original hip replacements were functioning at the latest follow-up examination or at the time of death, a significant decrease in activity level as measured by functional scores was seen over time. Age and health related factors as opposed to implant failure serve to limit activity in this cohort at long-term follow-up.

67. Intra-Articular Cortisone Injection has Limited Clinical Benefit for Nonoperative Treatment of Femoral Acetabular Impingement with Labral Pathology

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OBJECTIVE: Intra-articular cortisone injection of the hip is commonly performed both as a confirmatory diagnostic test and also as a therapeutic treatment modality in patients with femoral acetabular impingement (FAI). However, to our knowledge, there is no published data documenting the clinical benefit of these injections in patients with FAI. Therefore, the purpose of our study is to assess the efficacy of intra-articular cortisone injection in patients with FAI and associated labral tear prior to hip arthroscopy. We hypothesize that intra-articular cortisone injection does not provide significant therapeutic benefit for the non-operative treatment of FAI with associated labral tear.

METHODS: The records of patients undergoing hip arthroscopy for FAI at our institution between January 2008 and October 2012 who agreed to participate in research were reviewed. A cohort of patients was identified that underwent a preoperative ultrasound or fluoroscopic guided intra-articular cortisone injection. Inclusion criteria were a diagnosis of FAI with labral tear, Tonnis grade 0 or 1, and minimum 50% pain relief during the anesthetic phase of the intra-articular injection. Exclusion criteria were patients with concomitant osteoarthritis as defined as Tonnis grade 2 or 3. Numerical rating scale (NRS) pain scores were prospectively recorded pre-injection, immediately post-injection, and at 14 day follow-up. An absolute change of 2 points on the NRS score at 14 days was considered the minimal amount of clinically significant pain relief. The type of steroid used was documented.

RESULTS: Thirty-five patients met our inclusion criteria and included 29 females (83%) and 6 males (17%) with a mean age of 34.4 ± 12.9 years. Seven patients had Tonnis grade 0 (20%) and 28 had Tonnis grade 1 (80%). Patients received anesthetic combined with methylprednisolone (21 patients), triamcinolone (12 patients), or betamethasone (2 patients) during the intra-articular injection. Median pre-injection NRS score was 6 (range 2-10). Median immediate post-injection NRS score was 2 (range 0-6). Median 14 day post-injection NRS score was 4 (range 0-10). Median absolute change in NRS score at 14 days was 0 (range 0-8) with 23 patients reporting no change (66%) and 11 patients (31%) reporting a change of ≥ 2 points. There was no significant difference in pain reduction between the different steroid preparations.

CONCLUSIONS: In patients with symptomatic FAI and associated labral pathology, our data indicates that intra-articular cortisone injection has limited clinical benefit in two-thirds of patients as a therapeutic non-operative treatment modality.

68. Disparity in Total Joint Arthroplasty Based on Insurance Payer Type

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INTRODUCTION: Equity in health care has become a focal point of debate, and significant disparities are known to exist. However, disparity in insurance payer types for total joint arthroplasty is poorly defined.

METHODS: We retrospectively reviewed 1,312 cases of elective primary total hip or total knee arthroplasty with available preoperative SF36 and WOMAC surveys, and 292 who completed a minimum of 12 months follow-up. Patients were stratified into groups based on one of four insurance types at our institution (State Supplemental Insurance Plan, Medicare, Medicaid, or Private Insurance) for comparison of social, demographic, and functional data. Categorical variables (race, gender, smoking history, diabetes status, and alcohol use), were analyzed using a standard Chi Squared analysis. Continuous variables (age, distance traveled, BMI, SF36 and WOMAC scores, total number of medical comorbidities, and ASA class) were analyzed with multiple pair-wise comparisons of the least mean squares. We applied a Turkey-Kramer adjustment to reduce the risk of a Type I error, and after this adjustment statistical significance was considered to be a $p<0.05$. We then conducted a multivariate analysis to identify independent predictors of SF36 and WOMAC functional status.

RESULTS: Preoperatively, State Care and Medicaid patients had few differences with each other, but both groups had lower SF36 and WOMAC scores across every category as compared to Medicare or Privately insured patients ($p<0.05$). In addition, both State Care and Medicaid groups had a higher incidence of current smoking, higher mean body mass index, and State Care patients traveled an average 29-30 miles farther for access to care ($p<0.05$). Payer type was an independent predictor of both preoperative SF36 and WOMAC functional scores in the multivariate analysis ($p<0.02$). Similar trends were seen in the sub-group with post-operative follow-up.

CONCLUSIONS: Significant differences exist between different insurance payer types in total joint arthroplasty, and further research is necessary in order to better inform health policy decisions

69. No Difference in Activity Levels Between Very Young and General Total Hip Arthroplasty Patients Following Surgery

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INTRODUCTION: Total hip arthroplasty (THA) is used with relatively high reservation in very young patients. A broad range of comorbidities and expected high patient activity levels are among other factors contributing to the reluctance toward THA in this group.

METHODS: Sixty-seven THA patients ≤ 30 years old were followed a mean of 6.2 years after surgery. Current University of California Los Angeles (UCLA) Activity and hip satisfaction visual analogue scores of these very young patients were compared with those of two additional groups: (1) general (i.e., >30 years old) THA patients (n=137) and (2) age- and comorbidity-matched patients without histories of hip disease or significant hip pain (n=99). Additionally, expected activity levels were collected and compared between very young and general THA patients. Data were analyzed using linear regression. Comparisons between groups were adjusted for sex and Functional Comorbidity Index (FCI).

RESULTS: Young THA, general THA, “no hip disease” patients reported current mean UCLA activity scores of 6.5, 6.3, and 6.5, respectively ($p=0.74$) (adjusted for sex and FCI, $p=0.63$). Crude analyses showed significant differences in hip satisfaction between young THA, general THA, and “no hip disease” patients (8.2, 8.2, 8.9, respectively) ($p=0.02$) (adjusted for sex and FCI, $p=0.09$). A trend existed in mean expected activity level between young and general THA patients after adjustment for sex and FCI (7.8 and 6.9, respectively) ($p=0.03$). FCI was negatively associated with current activity ($p<0.001$), expected activity ($p<0.001$), and hip satisfaction ($p<0.001$) after adjustment for case status and sex.

CONCLUSION: Activity is a strong driver for patients choosing to undergo surgery and an important indication for caution among surgeons. However, despite being younger, THA patients ≤ 30 years old do not appear to be more active than general THA patients. Comorbid disease status plays a large role in expectant activity, postoperative activity, and hip satisfaction. As general THA patients often have higher FCI scores, the nature of comorbidities unique to young THA patients may dissimilarly affect activity and satisfaction.

70. Determinants of Readmission: An Analysis of 28,041 Elective Arthroplasty Procedures

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INTRODUCTION: All-cause hospital readmission has been proposed as a metric of hospital quality. Reducing readmissions represent an opportunity to improve care and reduce costs. However, little is known about what factors influence or potentially predict hospital readmissions in orthopedic surgery patients. Our aim is to identify variables associated with readmissions following knee or hip arthroplasty.

METHODS: This is a retrospective cohort study using national Veterans' Affairs (VA) data from 2005 to 2009 for total, partial, and revision knee or hip arthroplasties. Patients were identified from the Surgical Care Improvement Project and matched to outcomes from the VA Surgical Quality Improvement Program. Risk factors for readmission within 30 days of hospital discharge were identified using chi-square tests. Logistic regression models assessed independent predictors of 30-day readmission at the patient level, and linear regression was used to estimate correlation with readmission rates at the hospital level.

RESULTS: A total of 2,044 (7.3%) readmissions occurred within 30 days following 28,041 elective arthroplasties (6.6% for 17,471 knee and 8.4% for 10,570 hip procedures, $p<0.0001$). Overall, 12.8% of patients experienced at least one post-operative complication and were more likely to be readmitted than those without a complication (25.2% vs. 4.6%, $p<0.0001$). Hospital acquired conditions (HAC) accounted for 42.2% (1,516 patients) of all complications. These conditions consisted of UTI (35.6%), surgical site infection (28.8%), VTE (23.9%), and pneumonia (19.1%). HACs were the strongest predictor of readmission for both knee (OR 7.76, 95% CI 6.45-9.34) and hip arthroplasties (OR 7.55, 95% CI 6.07-9.37). Readmission rates at the hospital level showed a weak correlation with facility HAC rates ($R^2=0.15$, $p<0.0001$).

CONCLUSION: Hospital acquired conditions are strongly associated with 30-day readmission rates at both patient and hospital levels following elective knee or hip arthroplasty. Efforts aimed at reducing these events will reduce costs and improve the safety of arthroplasty. Further research is needed to develop interventions reducing HACs.

71. Cementless THA Has Higher Incidence and Severity of Thigh Pain Than Surface Replacement

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(Presented by David B. Bumpass, M.D., St. Louis, MO)

INTRODUCTION: The purpose of this study is to determine where young, active patients experience pain and at what level of intensity following hip resurfacing (SRA) and total hip replacement surgery (THA).

METHODS: This multicenter study identified a cohort of young active patients at least one year post SRA or THA. Young active patients were defined as males age 18-60 and females age 18-55 with a pre-symptomatic UCLA score ≥ 6. Potential participants were mailed a letter explaining the study and asking them to complete a questionnaire. Participants were asked to indicate whether or not they experienced pain and to what level in eight anatomical areas of interest. Participants used a 0-5 pain scale, with 0 being “No Pain” and 5 being “Constant Pain”. Completed questionnaires were returned to their respective centers and de-identified data was sent to the coordinating center. For data analysis purposes, pain was considered to be “mild” if scored with a 0 or 1 (no pain or pain only with extreme activity). Pain was considered to be “moderate/severe” if scored between 2 and 5.

RESULTS: Two hundred and fifty questionnaires were returned (163 SRA/87 THA) from two centers. Sixty-eight percent of patients reported pain in at least one area. There was no difference in groin pain as reported by both SRA and THA patients (SRA=52/163, 32%; THA=22/85, 26%; $p=0.91$). THA patients reported more anterior thigh pain (SRA=15/163, 9%; THA=23/85, 27%; $p<0.0001$). In addition, this anterior thigh pain was more severe for THA patients (Pain >1: SRA=5/163, 3%; THA=12/85, 14%; $p=0.001$).

CONCLUSION: Most young, active patients experience pain after hip replacement. Patients with SRA and THA are equally likely to experience groin pain. Young, active patients who have had THA experience significantly more anterior thigh pain with a surprising number having severe anterior thigh pain.

72. The Effect of Femoral Anteversion on the Outcomes of Arthroscopic Iliopsoas Tenotomies

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BACKGROUND: Arthroscopic iliopsoas tenotomies can effectively treat painful snapping of the tendon. However, a recent study concluded that patients with increased femoral anteversion may be at increased risk of inferior clinical outcomes after this procedure. This study sought to clarify this issue by evaluating the effect of femoral anteversion on the outcomes of 80 patients that had arthroscopic iliopsoas tenotomies performed at the level of the lesser trochanter.

METHODS: From the senior author's data base of 870 hip arthroscopies, 80 patients that had an arthroscopic iliopsoas tendon release at the lesser trochanter, a complete set of standardized AP and lateral radiographs, and one or more years of follow-up were identified. Ogata and Goldsands' biplanar method of measuring femoral anteversion was employed, and patients were divided into two groups based on their femoral anteversion: low/normal (<25º; n=50, LA patients) or high anteversion (>25º; n=30, HA patients). All hips were assessed with Byrd's modified Harris hip scoring system (MHHS) prior to the tenotomy and at 3, 6, and 12 months after surgery.

RESULTS: Preoperative MHHS scores for the LA and HA patients averaged 38 and 44 points, respectively. After surgery, the 3-months scores averaged 79 and 75 points, the 6-month scores averaged 84 and 80 points, and the 12-month scores averaged 85 and 76 points, respectively. The average improvement in scores was 47 points in the LA patients, and 32 points in the HA patients. The 9 point difference in the average 12-month scores of the LA and HA patients was due in part to lower scores in the categories of distance walked (6 vs. 10 points), and presence and severity of a limp (6 vs. 10 points).

CONCLUSIONS: The MHHS scores of patients with increased (>25º) femoral anteversion were significantly lower and the improvement in scores 15 points less than patients with normal femoral anteversion one year after iliopsoas tenotomies. This study found that measurements of femoral version are of prognostic value and should be part of the preoperative assessment of patients with psoas tendinitis and a painful snapping tendon.

73. Minimum 10-Year Results of a Contemporary Cementless Acetabular Component

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INTRODUCTION: Cementless acetabular fixation has been shown to be more durable than cemented acetabular fixation in long-term follow-up studies of total hip arthroplasty (THA). However, first generation cementless components have had significant failures related to bearing surface wear. The purpose of our study was to evaluate a contemporary cementless acetabular construct with a minimum of 10 years follow-up.

METHODS: We prospectively evaluated 200 primary THAs (186 patients) performed by two surgeons. Average age at operation was 60 years old. The same contemporary cementless acetabular component was used in all cases. 154 of the hips (77%) had cross-linked and 46 (23%) had conventional gas plasma sterilized polyethylene. Patients were evaluated clinically for need for revision as well as with SF-36, WOMAC, Harris Hip Score, Tegner, and UCLA activity-level scores. Pedometer measurements were also obtained. Radiographic evaluation consisted of osteolysis, loosening, and the measurement of bearing surface wear using edge detection techniques.

RESULTS: At a minimum 10-year follow-up, 147 patients (160 hips) were living, 27 patients (28 hips) were deceased, and 11 patients (11 hips) were lost to follow-up. Five of the hips within the study group (2.5%) required revision at an average of 6.0 years postoperative (2 dissociated liners, 1 femoral loosening, 2 dislocations). None were revised for wear of the acetabular liner. All acetabular components were bone ingrown. Osteolysis occurred proximally around one femoral component, and none were observed around an acetabular component. The average UCLA and Tegner activity-level scores were 5.2 and 3.5, respectively, which correlates to moderate activity. The average linear wear rate was 0.06 mm/year (0-0.24) with a significant difference between the cross-linked and non-cross-linked group ($p<0.05$).

CONCLUSIONS: At minimum 10 year follow-up, the contemporary acetabular component demonstrated excellent fixation (no loosening) and excellent bearing surface wear resistance (only 77% of cases with moderately x-linked polyethylene), which encourage us to continue using an x-linked polyethylene bearing surface in all patients.

74. Significance of MRI Findings of Iliopsoas Atrophy After Arthroscopic Tenotomies

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INTRODUCTION: Iliopsoas muscle atrophy is a known consequence of open iliopsoas tenotomies, but the presence, severity, and significance of iliopsoas atrophy after arthroscopic tenotomies has not been reported.

METHODS: Twenty patients who had arthroscopic, lesser trochanteric iliopsoas tenotomies and MRIs obtained postoperatively to assess their hip joint for recurrent hip pain are the basis of this report. Each patient's pre- and postoperative MRI were examined independently by three musculoskeletal radiologists who graded the postoperative muscle atrophy from 0 (no fatty streaks) to 4 (>75% fatty infiltration). All hips also were assessed with Byrd's modified Harris hip scoring system (MHHS) prior to the release, six months after surgery, and at the time of their follow-up MRI.

RESULTS: Average time from psoas tenotomy to the postoperative MRIs was 1.9 years with 8 MR examinations performed within the first year, 7 at 1-2 years, and 5 at 3-5 years after tenotomy. None of the patients had psoas or iliacus muscle atrophy on the preoperative MRIs. In contrast, 18 of the 20 patients had atrophy on their postoperative MRIs with 8 patients having grade 4 atrophy, 6 grade 2-3 atrophy, and 4 grade 1 atrophy. Sixteen (80%) of the 20 patients had atrophy in both the psoas and iliacus muscles and 4 had grade 4 atrophy in both muscles. Grade 4 atrophy was seen on MRIs obtained three years after tenotomy. The average one-year MHHS scores of the 8 patients with grade 4 atrophy was 79 points, and the average MHHS scores for the 6 patients with grade 2-3 and the 6 patients with grade 0-1 atrophy were 84 and 89 points, respectively. The average age of the patients with grade 4 atrophy (41 years) was significantly higher than the average age of those with minimal (grade 0-1) atrophy (26 years). The 10-point difference in the average scores of the grade 4 and grade 0-1 patients was due to lower scores in distance walked (6 vs. 10 points), and the presence and severity of a limp (6 vs. 10 points).

CONCLUSIONS: Grade 4 muscle atrophy occurs and persists after arthroscopic iliopsoas tenotomies and patients with high grade atrophy have significantly lower one-year MHHS (79 vs. 89 points) than patients with minimal atrophy.

75. Direct Anterior vs. Posterior Approach for Total Hip Arthroplasty: A Perioperative Outcomes

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INTRODUCTION: The direct anterior approach (DAA) for total hip arthroplasty (THA) has gained popularity largely due to its use of a true intermuscular plane and intraoperative fluoroscopy, which many believe results in better perioperative outcomes. However, comprehensive clinical comparative studies are lacking on this topic, particularly involving the common posterior approach.

METHODS: We reviewed 404 primary uncemented THAs performed by a single surgeon between July 2009 and May 2012. The mini-posterior approach (MPA) was used until March 2010 (n=98). Afterwards, the DAA was used (n=306). Operative time, blood loss, hemoglobin/ hematocrit levels, length of stay, discharge disposition, ASA class, pain scores, complications, and transfusion requirements were compared between cohorts. Subgroup analysis was performed to evaluate increased surgeon experience on outcomes. Radiographs were used to measure cup position postoperatively to assess accuracy by approach.

RESULTS: DAA THA was associated with a significantly shorter hospital stay (2.6 vs. 3.1 days, $p<0.05$), but had longer operative time, greater blood loss, and a higher transfusion rate compared to MPA THA ($p<0.05$). Postoperative hemoglobin and hematocrit levels were significantly lower with DAA. No differences were seen in pain level at discharge, proportion of patients discharged home, dislocation rate, or surgical complication rate. DAA subgroup analyses demonstrated significant reductions in operative time, blood loss ($p<0.05$) with increased experience; transfusion requirements decreased in ASA III patients only ($p=0.004$). Mean anteversion and inclination angles were significantly different between DAA and MPA groups (20.7° and 37.6° vs. 15.4° and 43.7°, respectively; $p<0.05$). The number of cups within the Lewinneck safe zone was similar between groups; however, the DAA cohort had significantly more cups within the Seki safe zone ($P=0.005$).

CONCLUSION: The costs of increased operative time, blood loss, and blood transfusion with DAA compared to MPA must be weighed against the reduction in inpatient length of stay.

76. An Association of Lateral Knee Sagittal Anatomic Factors with Non-Contact ACL Injury: Sex or Geometry?

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BACKGROUND: Lateral tibiofemoral articular geometry may play a role in the development of non-contact ACL injuries. We hypothesized that ACL-injured athletes would demonstrate more highly convex lateral joint surfaces compared to activity-matched uninjured athletes, and these attributes would be represented in all females.

METHODS: 173 activity-matched uninjured and non-contact ACL-injured athletes were studied. Three blinded observers made MRI measurements of sagittal articular geometry in the lateral mid-weight-bearing sagittal plane. Tibial plateau radius of curvature (TPr), distal femoral radius of curvature (Fr), maximum anteroposterior femoral articular length (FAP), and anteroposterior tibial articular length (TPAP) were recorded. Calculations of Fr:TPr and FAP:TPAP adjusted for size variation. Interclass correlation coefficient and two-sampled Student's T-tests were used to compare quantitative variables. Data represented a normal distribution.

RESULTS: Mean TPr, Fr, and TPAP were significantly smaller in combined-gender ACL-injured versus non-injured groups (33.8 vs. 37.4 mm, p=0.005; 25.1 vs. 24.3 mm, p=0.04; 31.5 vs. 33.1 mm, p=0.007; respectively). ACL-injured males had significantly smaller TPr (41.1 vs. 35.5 mm, p=0.002), Fr (26.7 vs. 25.5 mm, p=0.001), and TPAP (35.5 vs. 33.0 mm, p=0.0002). No significant differences existed between ACL-injured and uninjured females with respect to any measured variables. No differences existed between ACL-injured males, uninjured, or injured females with respect to FAP:TPAP or Fr:TPr.

CONCLUSIONS: All females and ACL-injured males shared a common lateral knee geometry characterized by a short tibial plateau and more convex articulating surfaces of the proximal tibia and distal femur. Shorter, highly-convex articulating surfaces may be inherently less stable to anterior tibial translation and rotation. These findings may partially explain the female predilection for ACL-injury compared to males.
Level III: Case control study

77. The Adverse Effect of Femoral Nerve Blockade on Quadriceps Strength and Function After ACL Reconstruction

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INTRODUCTION: Currently, there is no data assessing quad strength following femoral nerve blockade (FNB) for postoperative analgesia following anterior cruciate ligament reconstruction (ACLR). Therefore, we designed a comparative study to compare quad strength following ACLR with BTB autograft in a group of patients receiving a continuous FNB (FNB group) versus a group of patients with no FNB (control group). We hypothesize that the FNB group will have decreased quad strength compared to the control group.

METHODS: A retrospective case control study was designed to have sufficient statistical power to detect a 20% difference between groups with a sample size of 208 patients (104 in each treatment group). The records of all patients who underwent primary ACL reconstruction with BTB autograft between 2005 and 2011 at our institution were reviewed. Both groups underwent an identical postoperative rehabilitation protocol. At six months following ACL reconstruction, isokinetic strength data, expressed as a percentage of the contralateral extremity, was analyzed between the two groups with an alpha value <0.05 as significant.

RESULTS: The FNB group consisted of 104 patients (68 female, 36 male) with an average age of 21.4 years (range 14-55), and the control group consisted of 104 patients (42 female, 62 male) with an average age of 20.2 years (range 14-39). At six months, fast quad isokinetic strength was worse in the FNB group (77% vs. 85%; $p<0.01$). Slow quad isokinetic strength was also worse in the FNB group (71% vs. 76%), but did not reach significance ($p=0.06$). After adjusting for gender, both fast ($p=0.001$) and slow quad strength ($p=0.02$) were worse in the FNB group.

DISCUSSION AND CONCLUSION: In this retrospective comparative study, the hypothesis that patients treated with continuous femoral nerve blockade for postoperative analgesia following ACL reconstruction with BTB autograft will have worse quadriceps strength at six months follow-up was affirmed. The faster normalization of quadriceps strength suggests that the femoral nerve block may delay recovery in baseline quad muscle strength.

78. Gene Expression Differences in Young Male and Female Ruptured Anterior Cruciate Ligament Tissue

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INTRODUCTION: There is a greater incidence of anterior cruciate ligament (ACL) injuries among female athletes compared to males. Anatomic, hormonal, and neuromuscular factors have been indicated in this disparity. Research into whether actual genetic differences exist is limited. The purpose of this study was to compare gene expression in ruptured ACL tissue from young male and female athletes.

METHODS: A biopsy of ruptured ACL tissue was obtained intraoperatively from 7 male and 7 female young athletic patients. Biopsies were frozen-ground and extracted RNA was purified. Microarray analysis was performed using RNA isolated from 3 of the 7 male and 4 of the 7 female participants with non-contact injuries. Significant genes identified by microarray analysis were grouped into functionally associated networks using an Ingenuity systems (IPA) software analysis. Three genes of interest were chosen for further verification by quantitative reverse transcription-polymerase chain reaction (QRT-PCR) analysis from all 14 patients. Several statistical methods were used to examine data, with $p<0.05$ considered significant.

RESULTS: Statistically significant differences were found by microarray analysis for 14 genes that were not X- or Y-chromosome linked. The IPA analysis grouped these genes in skeletal muscular development and function and cellular growth, maintenance, and proliferation pathways. QRT-PCR confirmed statistically significant up-regulation of fibromodulin (FMOD) and aggrecan and down-regulation for WNT1 inducible signaling pathway protein 2 (WISP2) in gene expression of females compared to males.

CONCLUSION: Genes identified in this study as distinctly different produce major molecules in the ACL extracellular matrix. The significant up-regulation of proteoglycans (aggrecan) and FMOD (extracellular matrix-regulating protein) and down-regulation of WISP2 (involved in collagen turnover and production) may account for weaker ACLs in females than in males. This study is the first to use microarray analysis to compare male and female ruptured ACL tissue and to show that gene differences may contribute to the increased frequency of such injuries in females.

79. Differences in Short-Term Complications Between Spinal and General Anesthesia for Primary Total Knee Arthroplasty

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INTRODUCTION: Spinal anesthesia has been associated with lower deep venous thrombosis rates, shorter operative time, and less blood loss when compared to general anesthesia.

METHODS: The ACS NSQIP database was queried for patients undergoing primary TKA between 2005 and 2010. The 30-day complications of all those undergoing either general or spinal anesthesia were identified. Patient characteristics, 30-day complications, and mortality were compared. Multivariate logistic regression identified predictors of 30-day morbidity and stratified propensity scores were used to adjust for selection bias.

RESULTS: 14,052 cases of primary TKA were identified; 6,030 (42.9%) were performed under spinal anesthesia and 8,022 (57.1%) under general anesthesia. The spinal anesthetic group had a lower unadjusted frequency of superficial wound infections (0.68% vs. 0.92%; p=0.0003), blood transfusions (5.0% vs. 6.1%; p=0.0086), and overall complications (10.72% vs. 12.34%, p=0.0032). The length of operation (96 vs. 100 minutes; p<0.0001) and hospital stay (3.45 vs. 3.77 days; p<0.0001) were shorter with spinal anesthesia. After adjusting for potential confounders, the overall likelihood of complication with general anesthesia was significantly higher (odds ratio 1.129; 95% CI 1.004-1.269). Patients with the highest number of pre-operative co-morbidities, as defined by propensity score matched quintiles, demonstrated significant differences (11.63% vs. 15.28%; p=0.0152) in short-term complication rates. Age, female gender, black race, elevated creatinine, ASA class, operative time, and anesthetic choice were all independent risk factors of short term complication after TKA.

CONCLUSION: TKA patients undergoing general anesthesia had a small, but statistically significant increased risk of complications as compared to patients who received spinal anesthesia; a difference greatest in patients with multiple comorbidities. In light of these results, knee arthroplasty surgeons should consider spinal anesthesia in the co-morbid patient.

80. FSTL3 Mediates Exercise-Driven Bone Formation

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INTRODUCTION: Exercise promotes bone remodeling, forming in response to mechanical loading and resorbing following sustained unloading. How exercise drives the mechanoresponsiveness in bone is still elusive. Here, we provide evidence that Follistatin-like3 (*Fstl3*) could be a mechanoresponsive protein that takes part in exercise-driven bone formation.

METHODS: Wild-type rats/mice and FSTL3-/- mice were exercised by treadmill walking (TW) and following 0, 2, 5, or 15 days of exercise, sacrificed and distal femurs analyzed by PCR, Western blots, or immunohistochemistry. Bone mineral apposition rates (MAR) of mice were assessed using Calcein and Alizarin complexones injected on Day 3 and 12, respectively. On Day 15, femurs were excised, sectioned, and subjected to fluorescence microscopy to examine bone remodeling. Statistical analysis was performed by one-way ANOVA with Tukey's post hoc or T-test.

RESULTS: TW stimulated a ~6 fold increase in *Fstl3* mRNA expression in trabecular bone and bone marrow cells on Day 2, declining by Day 5. A robust increase in *Fstl3* was observed in cells adjacent to trabecular bone and in osteocalcin positive osteocytes in cortical bone. *Fstl3*+/+ or *Fstl3*-/- mice subjected to TW for 15 consecutive days and injected with Calcein and Alizarin revealed significant increase in bone deposition on the periosteal surface of the femur and in the total MAR. However, bone deposition in both groups of non-exercised controls was limited. Similar treatment failed to induce exercise-induced bone formation and MAR increases in *Fstl3*-/- mice. *Fstl3*-/- mice also exhibited weaker femurs and brittle bones.

CONCLUSIONS: Our data suggest that *Fstl3* is the first molecule identified that might be critical for bone formation and strengthening in response to mechanical loading. This is evident by observations that genomic deletion of *Fstl3* abolishes load-dependent bone formation, weakening bones with failure to upregulate genes associated with bone deposition. The identification of *Fstl3* as a mechanoresponsive protein provides a new paradigm for investigating exercise-driven bone formation and its use as a target to develop therapeutic drugs for treating bone diseases.

81. Ten-Year Outcome of Serum Metal Ion Levels After Primary Total Hip Arthroplasty

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INTRODUCTION: It has been established that serum metal ion levels are increased following primary total hip arthroplasty (THA) with all head and liner articulation couples. Studies have documented local soft tissue reactions, pseudotumor formation, systemic effects, and end-organ deposition with elevated serum metal ion concentrations from metal-on-metal THA. All metallic components of joint replacements are subject to electrochemical corrosion potentially resulting in the formation of chemically active metal degradation products. The purpose of this prospective, controlled, longitudinal study was to determine the long-term changes in serum metal ion concentrations of cobalt, chromium, and titanium in patients with primary metal-on-polyethylene THA at ten-year follow-up.

METHODS: Forty patients (average: 60 years old, range: 37-80) were included in this study that was approved by the appropriate Institutional Review Board. Ten patients received a hybrid THA that consisted of a modular cobalt-alloy femoral stem and head inserted with cement and titanium acetabular socket inserted without cement (Hybrid). Nine patients were implanted with an extensively-porous coated modular cobalt-alloy stem and head along with a titanium socket without cement (CoCr), and eight underwent insertion of a proximally porous-coated modular titanium-alloy stem and cobalt-alloy head with titanium socket without cement (Ti). Thirteen patients did not receive an implant and served as control subjects (Control).

Blood samples were collected preoperatively and at 12, 36, 60, 84, 96, 108, and 120 months after surgery. Serum samples were analyzed for cobalt, chromium, and titanium levels using high-resolution sector field inductively-coupled plasma mass spectrometry (HR-SF-ICPMS) using the method of additions with detection limits of 0.04 ng/ml for cobalt, 0.015 ng/ml for chromium, and 0.2 ng/ml for titanium. Intergroup comparisons were made with Wilcoxon-Mann-Whitney tests and intragroup longitudinal comparisons were made with Friedman tests with significance set at $p<0.05$.

RESULTS: Ten-year data was available for all 40 patients. Hybrid THA had mean cobalt levels 3.2 times higher at 120 months compared with baseline and elevated cobalt concentrations compared with Ti THA at 36, 60, 84, 96, and 120 months ($p<0.01$). Hybrid THA had mean chromium levels 3.9 times higher at 120 months compared with baseline, and CoCr THA had chromium levels 3.6 times higher at 120 months than baseline. Serum titanium levels were higher in Ti THA compared to all other groups at all follow-up time intervals with levels at 120 months 18 times higher than baseline ($p<0.01$).

CONCLUSIONS: The main finding of this study was that patients with well-functioning primary metal-on-polyethylene total hip replacements had elevated serum metal ion levels up to ten years after surgery. Analysis of metal ion level trends between Hybrid, CoCr, and Ti groups showed that metal ion release at the modular head-neck junctions of implants, rather than

passive dissolution from porous in-growth surfaces was the dominant source of serum cobalt and chromium ions.

The present study contributes to the understanding of long-term changes in serum metal ion levels after primary THA and how they are influenced by component composition and taper geometry. In addition, this study provides normative data on patients with metal-on-polyethylene THA that can be useful in evaluating patients with suspected adverse local tissue reactions to mechanically assisted crevice corrosion. The toxicological risks of metal ions from joint arthroplasty are a growing concern and represent an area of much needed investigation as the number of patients receiving implants continues to rapidly increase.

82. Dexamethasone Reduces Length of Hospitalization and Improves Postoperative Pain and Nausea After Total Joint Arthroplasty: A Prospective, Randomized Controlled Trial

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Matthew D. Clayton, M.D.	Columbus, OH
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Dr. Backes is the recipient of the Carl L. Nelson, M.D. Physician in Training Award.

Controlling postoperative pain and nausea after total joint arthroplasty remains an important challenge. We conducted a prospective, randomized controlled trial with 120 patients to determine if the addition of perioperative dexamethasone to a multimodal regimen improves antiemetic and analgesic control, enhances mobility, and shortens hospital length of stay after total hip and knee arthroplasty. Patients administered 10 mg of intravenous dexamethasone intraoperatively consumed less daily rescue anti-emetic and analgesic medication, reported superior VAS nausea and pain scores, ambulated further distances, and had a significantly shorter length of stay compared to the control group ($p<0.05$). A second, 24-hour postoperative dose of 10 mg intravenous dexamethasone provided significant additional pain and nausea control and further reduced length of stay ($p<0.05$). No adverse events were detected with the administration of the intraoperative and/or postoperative dexamethasone.

83. Influence of Bisphosphonate Pretreatments on Osseous Incorporation and Chondrocyte Viability within Fresh Osteochondral Allografts in Cold Storage♦

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

PURPOSE: The purpose of this study was to investigate the effect of adding non-nitrogenated versus nitrogenated bisphosphonates to fresh osteochondral allograft storage media on chondrocyte viability, proteoglycan content, and osseous incorporation.

METHODS: *Chondrocyte Viability:* 50, 10 mm osteochondral cores were obtained from hemi-condyles of distal femurs from two male cadaveric donors and immediately immersed in fresh graft storage media in as-supplied condition (control), or augmented with low dose (0.01M) or high dose (0.1M) etidronate (non-nitrogenated bisphosphonate) or risedronate (nitrogenated bisphosphonate). Cores were examined at 15, 35, and 43 days with Safranin-O/Fast green staining to assess relative proteoglycan content and TUNEL to determine chondrocyte viability. *In vivo osseous incorporation:* After IACUC approval, 6 mm osteochondral cores were harvested from a Yucatan miniature pig's femoral trochlea. The cores were either stored in control storage media or augmented with 0.1 M etidronate, or 0.1M risedronate. After 13 days, they were implanted into the knees of two recipient pigs. At six weeks, the pigs were euthanized and micro-CT was performed to examine osseous incorporation.

RESULTS: Low dose and high dose risedronate-treated grafts displayed the most intense (red/orange) staining for proteoglycans at 16 and 43 days. Interestingly, at 35 days etidronate-treated grafts displayed the most intense staining. Chondrocyte viability within the osteochondral cores displayed a dependence on both type and concentration of bisphosphonates. Viability was highest in low dose risedronate, followed by high dose risedronate, control samples, and samples treated with etidronate. Micro-CT demonstrated improved osseous incorporation of osteochondral plugs pretreated with bisphosphonates.

CONCLUSION: The addition of nitrogenated bisphosphonates to fresh osteochondral allograft storage media results in higher chondrocyte viability, proteoglycan content and in vivo osseous incorporation of grafts.

MAOA BREAKOUT SESSION #6
TOTAL JOINT COMPLICATIONS
April 19, 2013

84. Preliminary Data on Use of Tranexamic Acid in High Risk Patients Undergoing Primary Total Hip and Knee Arthroplasty♦

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INTRODUCTION: The use of antifibrinolytics, such as tranexamic acid (TA), in total hip and knee arthroplasty (THA and TKA) has been shown to reduce intraoperative blood loss and decrease postoperative transfusion rates. Despite their safety profile, concerns exist regarding a potential increase in thromboembolic events (TEE) following THA and TKA in patients with known risk factors. The objective of this paper is to report the thromboembolic complications associated with use of TA in high risk patients and compare this to a control group not receiving TA.

METHODS: 236 patients with an American Society of Anesthesiologists physical classification score of III or IV undergoing primary THA and TKA by three surgeons during 2007-2009 were retrospectively reviewed. Patients were stratified according to cardiovascular risk factors presumed to increase the risk of TEE from TA administration including: prior deep vein thrombosis (DVT), pulmonary embolism (PE), myocardial infarction (MI), cerebrovascular accident (CVA), coronary artery stent placement, coronary artery bypass graft (CABG), or prothrombotic condition (i.e., Factor V Leiden deficiency). Patients were further stratified as to whether or not they received intraoperative TA. Primary outcome measures were post-operative TEE including DVT, PE, MI, and CVA. Contingency tables with a Pearson coefficient were used for statistical analysis.

RESULTS: 180 patients received TA intraoperatively. The rate of TEE with and without TA was 6.1% and 1.8% respectively, but this did not reach statistical significance with the numbers available (p=0.1982). Within the TA group, there were eight (4.4%) venous thromboembolic complications, compared to one (1.8%) in the no TA group (p=0.3643). Within the TA group, there were two CVAs and one MI; none were identified in the group not receiving TA.

CONCLUSION: Although there was no statistically significant difference in TEE between these groups, its three-fold increase in the high risk patients receiving TA is clinically concerning and warrants further investigation.

85. Predictors and Risk Stratification of Hospital-Acquired Conditions After Elective Joint Arthroplasty

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INTRODUCTION: Medicare and Medicaid require a reduction in Medicare Severity Diagnosis Related Group payments for certain hospital-acquired conditions (HAC). Some of those, including surgical site infections (SSI), catheter-associated urinary tract infection (UTI), and venous thromboembolism (VTE), are potential complications after elective total joint arthroplasty (TJA). These conditions are currently reported and drive payment and quality assessment regardless of age and comorbidities. A risk stratification system is needed for prevention and fair determination of quality and reimbursement. The purpose of this study is to identify predictors of HAC and quantify their risk in a large cohort of patients that underwent TJA in a tertiary health care center.

MATERIALS AND METHODS: A cohort of 26,391 patients that underwent elective primary TJA was reviewed retrospectively. Demographics, body mass index (BMI), and comorbidities were identified using electronic medical records. The incidence of SSI, UTI, and VTE was established. Adjusted hierarchical stepwise multivariate regression models were used to analyze independent risk factors for HAC. A risk stratification system was developed using risk groups as low, medium, or high. Finally, an internal validation was performed using a penalized logistic regression method.

RESULTS: Incidence of SSI, UTI, and VTE was 1.0%, 1.1%, and 1.2% respectively. Independent predictors of SSI within one year postoperatively were ischemic heart disease, congestive heart failure, valvulopathy, connective tissue disease, diabetes mellitus, and elevated BMI. Independent predictors of UTI within 90 days postoperatively were urinary incontinence, anemia, ischemic heart disease, female gender, hypertension, and increased Charlson Comorbidity Index (CCI). Independent predictors of VTE within 90 days postoperatively were knee surgery, history of VTE, chronic obstructive pulmonary disease, atrial fibrillation, anemia, depression, increased CCI, and increased BMI. Each independent predictor was quantified with a certain amount of points depending on its correlation with the risk of having the studied HACs.

CONCLUSIONS: There is a significant difference between patients with respect to the risk of developing HACs after TJA, based on multiple variables including gender, comorbidities, and BMI. Based on this premise, it would be inappropriate to assume that all patients should be considered equal when assessing risk to develop HACs after TJA. This risk stratification model can be used when assessing quality and reimbursement of TJA procedures.

SUMMARY: A risk stratification model for hospital acquired conditions was developed. This may be used when assessing quality and reimbursement of such procedures.

86. Combined Measured Resection Predicts Alignment, but not Manipulation Rates in Knee Arthroplasty

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PURPOSE: The purpose of this study is to correlate the thickness of bone removed from the femur and tibia during a knee arthroplasty (TKR) with the change in coronal leg alignment and the knee manipulation rates. Our hypotheses are that the difference between the combined medial and lateral extension gaps (CME/CLE) affects coronal alignment, and that overall bone resection thickness relative to implant thickness does not affect the manipulation rate.

METHODS: This IRB-approved prospective cohort study enrolled 83 knee replacement patients. The intraoperative thickness of the resected bone from the distal medial/lateral femur, the posterior medial/lateral femur, and medial and lateral tibia were recorded using the InVivolink software. The resected distal medial femur was stacked onto the medial tibia to determine the CME; the CLE and the combined medial/lateral flexion gaps (CMF and CLF) were similarly determined. The preoperative and postoperative coronal alignments were determined from long leg x-rays.

RESULTS: The change in coronal alignment (ΔA) correlates to the CME and CLE by the following equation: $\Delta A = 1.3 * (CME-CLE) + 0.18$ (correlation coefficient = 0.66) as determined with the least squares method. The three manipulated TKR had an average difference between the implant thickness and the CME, CLE, CMF, and CLF of 2.8, -1.17, 3.8, and 1.8; the non-manipulated TKR difference was 3.0, 0.8, 2.4, 2.1 ($p=0.92$, 0.27, 0.36, and 0.87, respectively).

CONCLUSIONS: The change in coronal alignment can be predicted by measuring the difference between CME and CLE. A preoperative 10° varus deformity should have approximately 7 mm less bone removed from the CME than the CLE. Knee manipulations were not statistically related to the thickness of bone resection with our numbers; however, surgeons might want to avoid a tight medial flexion gap since the manipulated TKRs had 3.8 mm more implanted prosthesis than bone removed in the medial flexion gap.

87. Obesity is a Major Risk Factor for Postoperative Complications After the Periacetabular Osteotomy

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INTRODUCTION: The Bernese periacetabular osteotomy (PAO) has become the osteotomy of choice for the surgical treatment of symptomatic hip dysplasia. Obesity has been cited as an increased risk factor for progressive hip osteoarthritis and complications. The purpose of this retrospective study was to determine if obesity was a risk factor for the development of postoperative complications following the PAO.

METHODS: This study included patients who underwent PAO with a minimum one-year follow-up. Two groups were formed based on BMI: non-obese (BMI<30) and obese (BMI ≥ 30). Complications were recorded using a modified Clavien-Dindo system for hip preservation surgery. Complications were graded from 1 to 5 in severity. Statistical analyses were used to identify factors related to the development of a complication that necessitated treatment. Among subjects that developed a complication, an identical modeling strategy was used to identify factors predictive of a major complication.

RESULTS: This study included 240 patients, 66 in the obese group and 174 in the non-obese group; 24.6% males and 75.4% females with a mean age of 30.5 years and a mean follow-up of 3.5 years. 19.67% patients developed a complication that necessitated treatment. Obesity ($p<0.001$) and smoking status ($p=0.003$) were significantly related to the development of complication that necessitated treatment. After controlling for smoking status, the odds of a complication were 10.5 times greater for obese subjects compared to non-obese subjects. Smokers that developed a complication, the odds of a serious complication were 2.1462 times greater for an obese subject compared to a non-obese subject. Among non-smokers, the odds of a serious complication were 6.1627 times greater for an obese subject compared to a non-obese subject.

CONCLUSION: Obesity and smoking were independent predictors of the development of a complication after PAO. In this study, the odds of developing a complication were 10 times greater for an obese (BMI≥ 30) compared to a non-obese patient.

88. Decrease in Dislocation Rates in Liner and Head Exchange When Head Size is Increased

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INTRODUCTION: Isolated head and liner exchange is a viable option in hips with well-fixed acetabular and femoral components that experience polyethylene wear. Postoperative instability remains a concern with such practice. Larger head sizes became readily available after highly cross-linked polyethylene was introduced and are commonly used during revision THA, but whether dislocation rates after isolated head and liner exchange have decreased with larger head sizes is not known.

MATERIALS AND METHODS: We retrospectively reviewed 106 hips undergoing isolated head and liner exchange for polyethylene wear with a minimum of two year follow-up. Sixty-seven were men. Fifty-seven were revised through a posterior approach and the rest through an anterior approach. Fourteen of the 106 hips were revised at the time of a concomitant dislocation resulting from marked polyethylene wear. Special emphasis was made as to the dislocation rates with respect to the number of head sizes increased (i.e., 28 to 32 or 36 [either 1 or 2 head sizes]) for example.

RESULTS: The overall dislocation rate was 10.3%. Four of the 14 hips presenting with a concomitant dislocation and wear had further episodes of instability and the rate was higher than the rest of the cohort ($p=0.0273$). There was a trend towards higher dislocation rates when the revision was performed through the posterior approach (15.7 vs. 4%: $p=0.06$). Those patients without instability had an increase in head size of 1.46 times compared to 1.31 times in the group with instability ($p=0.027$). Three patients required revision: two for infection and one acetabular loosening.

DISCUSSION: Despite the use of larger head sizes, the dislocation rate after isolated head and liner exchange remains high. Increasing head size to the maximum head size allowable appears to be the safest treatment strategy as dislocation rates were lower when the head size was increased up to two standard head sizes from the original one. Cup revision may be a better option in cases where head size cannot be upsized at the time of head and liner exchange.

89. Economic Impact of Tranexamic Acid in Healthy Patients Undergoing Primary Hip and Knee Arthroplasty♦

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INTRODUCTION: Antifibrinolytics such as tranexamic acid (TA) have been shown to reduce intraoperative blood loss and decrease transfusion rates with minimal complications post-operatively in total joint arthroplasty [HMS1]. However, it is unknown if the potential cost savings from decreased OR time, blood transfusions, and hospital stay offsets the additional expense of the drug and its administration.

METHODS: Patients undergoing primary total hip or knee arthroplasty at a single institution during 2007-2008 were retrospectively reviewed. Patients with an American Society of Anesthesiologists (ASA) physical status classification of III [HMS1] or greater and another surgery within 90 days were excluded. The estimated mean total direct hospital costs as well the operating room (OR), blood transfusion associated, room and board, and pharmacy costs were compared between patients who did and did not receive TA. Direct medical costs were calculated by using standardized, inflation-adjusted costs for services and procedures billed during hospitalization and analyzed with student t-tests.

RESULTS: 1,018 patients met inclusion criteria for this study with 580 patients who received TA compared to 438 who did not. The mean total direct cost of hospitalization with and without TA was $15,099 and $15,978 ($p<0.0002$) respectively, a difference of $879. The operating room cost was $3,418 and $3,640 respectively ($p<0.0001$). The associated blood/laboratory cost was $361 and $500 ($p<0.0001$). For room and board, the mean cost respectively was $2,835 and $3,292 ($p<0.0001$). The only increased cost associated with TA was the pharmacy cost which was $921 and $781 respectively ($p<0.0001$).

CONCLUSION: The increased mean pharmacy cost was offset by cost savings in OR, blood/laboratory, as well as room and board costs as seen by the statistically significant decreased mean total inpatient cost. Tranexamic acid may be considered for use in total hip and knee arthroplasty patients not only for the presumed benefit of decreased blood loss, transfusion rates, and hospital stay, but also for estimated mean hospital cost savings.

90. Intraoperative Fracture During Staged Total Knee Reimplantation in the Treatment of Periprosthetic Infection

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OVERVIEW: Bone stock at the time of a staged total knee reimplantation following an infection is often compromised. This may lead to an increased risk of intraoperative fracture, the incidence of which has yet to be reported in the literature. This study aims to describe the incidence of intraoperative fracture, report the locations of their occurrence, and detail their treatment.

METHODS: A retrospective review was performed using our institution's total joint registry. Patients who sustained an intraoperative fracture during a staged reimplantation with a minimum of two-year clinical follow-up, or underwent re-revision within two years, were selected for analysis. The portion of the procedure during which the fracture occurred, fracture location, and treatment were recorded. Fracture healing, component stability, and re-operation were utilized as outcome measures.

RESULTS: Between 1990 and 2010, 894 patients were treated with a staged reimplantation knee arthroplasty for the treatment of a periprosthetic infection. Twenty-three intraoperative fractures occurred in 21 patients (2.3%). Twelve patients were female and nine were male, with an average age of 67 years. Their average clinical follow-up was 55 months. Seven fractures occurred in the tibia, 3 occurred in the patella, and 13 occurred in the femur. Four occurred during component resection, while 19 occurred during reimplantation. Most fractures were treated with observation/limited weightbearing or wires/cables. At final follow-up, 21 fractures (89%) demonstrated a bony union. Additionally, 75% of patients demonstrated stable components at final follow-up. Eight re-revisions were required (38%) at a mean of 36 months.

CONCLUSIONS: Patients undergoing a staged total knee arthroplasty reimplantation for treatment of a periprosthetic infection have an increased risk of intraoperative fracture. Treatment of these fractures usually results in fracture union; however, patients in whom this intraoperative complication occurs appear to have an increased risk for future component loosening and need for re-revision.

91. Early Failure Patterns of a Modern Constrained Acetabular Liner Design

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At short-term follow-up, a modern constrained acetabular liner experienced dislocation or disassembly by one of three failure modes.

METHODS: Between 01/01/2008 and 12/01/2011, 71 hips underwent revision utilizing a recently introduced constrained liner with a cut out of the poly for increased range of motion and a ring that locks the femoral head in place. Twenty-seven were placed at the time of acetabular component revision to prevent instability in patients with a previous history of instability, and 44 were cemented into a well fixed acetabular shell as specific treatment for hip instability. Previous surgeries ranged from 1 to 18. We reviewed the clinical and radiographic data of all patients to identify failure mechanisms for this specific liner and post revision functional outcomes.

RESULTS: Nine of 71 patients (12.7%) failed through the constrained liner at a mean time to revision/re-dislocation of 10 months (range 1-40 months). Of these, eight patients had their constrained liner cemented into a previously well-fixed acetabular shell. One liner was secured via snap-fit technique into a well fixed shell. No liners failed when the insertion was done after revision of both the liner and shell. In six hips (8.5%), the mode of failure was dislocation of the femoral head from the constrained liner despite an intact locking ring mechanism. Two hips showed catastrophic fracture of the liner with breakage at the periphery. In one hip, the locking ring displaced allowing dislocation. The average follow-up for the remaining well-functioning hips was 15.6 months (range 1-37 months) with an average Harris Hip Score of 74 (range 28-97) at final follow-up.

DISCUSSION AND CONCLUSION: Constrained sockets have historically had relatively high mechanical failure rates attributed in part to reduced range of motion to impingement. Despite a specific new design aimed at improving range of motion to impingement, early failure by redislocation and disassembly via three modes was observed. Constrained liners should continue to be used as salvage for hips that cannot be rendered stable with conventional implants and methods.

92. Osteolysis and the Acetabular Component in Total Hip Arthroplasty: A Computed Tomography-Based Assessment of Stability

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INTRODUCTION: Polyethylene wear (PE) and osteolysis remain major obstacles to the long-term durability of total hip arthroplasty (THA); however, the specific anatomic factors that determine component stability are poorly understood. In this study, we sought to determine what patterns of bony ingrowth about the acetabular component as seen on computed tomography (CT) scan could predict acetabular component stability.

METHODS: From an initial pool of 192 patients who underwent revision THA, we found 78 patients who met the study criteria. All CT scans were then evaluated for the presence of bony ingrowth in one of 12 sectors. Sectors were determined by dividing the cup into four sections on coronal imaging as defined by Charnley-Delee (CD) and three sections on sagittal and axial imaging. Regression analysis was combined with Categorization and Regression Tree analysis to determine what sectors and what size of bony ingrowth was predictive of acetabular component stability.

RESULTS: In the population of 78 patients, 68 patients had stable cups intraoperatively. Bony ingrowth of greater than 5x5 mm in Sector CD1 Anterior ($p=0.022$) and CD3 Middle (0.001) was associated with acetabular component stability as was ingrowth of 10x10 mm in Sector CD3 Posterior ($p=0.003$). Presence of bony ingrowth in Sector CD3 Middle and CD3 Posterior has 74% sensitivity and 100% specificity for cup stability. The combination of these two criteria combined with bony ingrowth in Sector CD1 Anterior is 94% sensitive and 70% specific for cup stability.

DISCUSSION: In our study, bony ingrowth along the posterior aspect of the cup was highly specific for cup stability while both anterior and posterior bony ingrowth was highly sensitive for cup stability. We believe this Sector-based method may be useful for determining acetabular component stability in the setting of osteolysis.

93. Impact of Socioeconomic Factors on Results of Total Knee Arthroplasty

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INTRODUCTION: Predictors of outcomes of total knee arthroplasty (TKA) have focused primarily on surgical technique, implant details, and individual patient clinical factors. There is very little data available on socioeconomic factors.

METHODS: A multicenter survey was conducted with patients age 18-60 who underwent TKA for non-inflammatory arthritis at one of five orthopedic centers. Data were collected by an independent third party with expertise in collecting health care data for state and federal agencies.

RESULTS: Demographic data were collected on 661 patients (average age 54; 61% female) 1-3 years following modern primary TKA. We looked at a specific series of questions regarding pain, function, and satisfaction after TKA and examined the following socioeconomic factors: minority status (African American or Hispanic), gender, household income, and education (high school graduates or less vs. post-high school education). Minority patients were more likely to express difficulty with getting in and out of a car ($p=0.0038$), in and out of a chair ($p=0.0016$), up and down stairs ($p=0.0434$), knee pain ($p=0.048$), and limp while walking ($p<0.0001$). Females expressed more difficulty with going up and down stairs ($p=0.0007$) and knee pain ($p=0.0105$) and were less satisfied with the overall functioning of their knee after surgery ($p=0.0017$). Patients in the lowest quartile of household income expressed more difficulty with getting in and out of a car ($p=0.0001$), in and out of a chair ($p=0.0018$), up and down stairs ($p<0.0001$), knee pain ($p=0.0144$), limp while walking ($p=0.0019$), and were less satisfied with overall functioning of their knee after surgery ($p=0.0241$). Education did not show as many significant differences. Patients with less education responded that they limped more often while walking ($p=0.0027$).

DISCUSSION AND CONCLUSION: The results of this study indicate that socioeconomic factors may well be more important than surgical technique, implant details, and individual patient clinical factors in determining outcomes following TKA.

94. Metal-on-Metal Total Hip Arthroplasty at 5- to 9-Year Follow-Up

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INTRODUCTION: Concerns have arisen regarding the use of a metal-on-metal (MOM) bearing surface in THA. The purpose of this study was to evaluate the 5 to 9 year follow-up of a consecutive series of MOM THA using a modular metal shell with supplemental screw fixation.

METHODS: 169 consecutive metal-on-metal THAs were performed in 148 patients using a cementless acetabular component. Average age at surgery was 51.6 years and average BMI was 37. Patients were evaluated at 5 to 9 year follow-up for revision and with Harris Hip, UCLA, and WOMAC ratings. Radiographs were evaluated for loosening and osteolysis.

RESULTS: At final follow-up, 138 patients (157 hips) were living, 2 patients (2 hips) were lost to follow-up, and 8 patients (10 hips) were deceased. None of the hips in deceased patients required revision. Average clinical and radiographic follow-up of the living patients were 7 and 5 years, respectively. The average follow-up Harris Hip and UCLA activity scores were 90 and 5.7, respectively. Average WOMAC score for pain, stiffness, and function were 10, 19, and 14, respectively. Two hips required revision (1 for femoral osteolysis [no evidence of ALVAL at revision], 1 for femoral loosening). One additional femoral component demonstrated fibrous fixation. All other femoral and all acetabular components were well fixed. Osteolysis of less than 1x1 cm^2 was detected around 5 femoral and 3 acetabular components. At minimum 5-year follow-up, one hip demonstrated concern for an adverse local tissue reaction and is being closely followed.

CONCLUSION: At 5- to 9-year follow-up of this MOM THA construct, two hips required revision, neither of which was for reasons related to metal toxicity or adverse tissue response to metal. There are some cases with radiographically detected osteolysis (no symptoms) which are being closely followed with radiographs and ion levels. The entire group also is being closely surveilled.

95. Corrosion at the Head-Neck Taper as a Cause for Adverse Local Tissue Reactions in Total Hip Arthroplasty

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INTRODUCTION: Corrosion at the modular head-neck junction of the femoral component in total hip arthroplasty (THA) has been identified as a potential concern; however, symptomatic adverse local tissue reactions secondary to corrosion have rarely been described.

METHODS: We retrospectively reviewed 13 patients with a metal-on-polyethylene bearing who underwent revision surgery for corrosion at the modular head-neck junction. Patients presented with pain or swelling around the hip and four presented with recurrent instability. Serum cobalt was typically elevated (mean 11.67 ng/mL; range 1.60 to 49.83) to a greater degree than chromium (mean 2.27 ng/mL; range 0.18 to 9.81). Surgical findings included large soft tissue masses and with visible corrosion at the head-neck junction. Patients were treated with debridement and a head and liner exchange, using a ceramic femoral head with a titanium sleeve in ten cases.

RESULTS: Harris Hip Scores improved from 56.5 to 87.9 points ($p=0.01$) at a mean of 12.5 months (range 1.5 to 30.9 months). Repeat serum cobalt levels, performed at mean of 7.5 months following revision decreased to a mean of 1.75 ng/mL (range 0.18 to 8.93), and chromium levels were similar to pre-revision levels with a mean of 1.35 ng/mL (range 0.16 to 3.16). Three complications occurred including recurrent instability, a sciatic nerve palsy, and a deep infection.

CONCLUSIONS: Adverse local tissue reactions can occur in patients with a metal on polyethylene bearing secondary to corrosion at the modular head-neck taper and present similarly to patients with a failed metal on metal bearing. A differential elevation in serum cobalt levels with respect to chromium levels can be helpful in making this diagnosis. Revision surgery with debridement and head and liner exchange using a ceramic head and titanium sleeve provided good short-term results.

96. Synovial Fluid Aspirations in Failed Metal-on-Metal (MOM) Total Hip Arthroplasty (THA)

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INTRODUCTION: Currently, WBC count and neutrophil percentage from preoperative synovial fluid aspirations are used to help determine the presence or absence of periprosthetic joint infection (PJI) in failed THA. The clinical levels indicative of infection are not well delineated in the prosthetic hip and especially between different types of bearing surfaces. We are unaware of any data comparing typical ranges of synovial fluid WBC count and neutrophil percentage in culture positive versus culture negative failed MOM THA. The purpose of this study is to use a relatively large case series to elucidate typical values for these metrics and determine their reliability in diagnosing PJI.

METHODS: We reviewed all patients receiving revision of a primary MOM THA at our institution between August 2006 and March 2012. From this cohort, 39 cases in 38 patients were identified that received a preoperative synovial fluid aspiration prior to revision of their implant. Data was collected preoperatively for aspiration WBC count and neutrophil percentage, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), serum cobalt and chromium, age, gender, reason for revision, and for culture results of intraoperative specimens.

RESULTS: It was determined that 35/39 cases were culture negative and 4/39 were culture positive for strains of methicillin-resistant Staphylococcus aureus (N=2), viridans group streptococcus (N=1), and group G streptococcus (N=1). While WBC count was 100% sensitive but only 57.1% specific (> 3,000 cells/microliter), neutrophil percentage was 100% sensitive and 97.1% specific (>80%). Both CRP and ESR were 75.0% sensitive and 67.6% specific (>8.0 mg/L and >22 mm/hour, respectively).

CONCLUSION: Our data suggests that synovial fluid WBC counts as well as serum ESR and CRP have poor predictive value in diagnosing PJI for failed MOM THA, whereas neutrophil percentage is a highly accurate marker for diagnosing infection in this patient population. These markers should be interpreted with caution in the case of MOM revisions; however, when looking at synovial fluid aspirations, the neutrophil percentage should take precedence over the WBC count as a data point for diagnosing PJI.

MAOA BREAKOUT SESSION #7
SHOULDER/TRAUMA
April 19, 2013

97. Identifying Outcomes of Humeral Windows and Longitudinal Splits in Patients with Revision Shoulder Arthroplasty – A Study of 427 Patients

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Removal of a well-fixed humeral component during revision shoulder arthroplasty presents a difficult problem. If the component cannot be extracted easily from above, an alternative approach must be taken that may include compromising bone architecture to remove the implant. Two potential solutions to this problem that allow removal of the prosthesis are creating a humeral window or a longitudinal split. Currently, there is minimal information on complications associated with these techniques. Therefore, this retrospective review was performed to determine complications associated with creating humeral windows and longitudinal splits during the course of revision shoulder arthroplasty. The study reviews records of 427 patients from 1994–2010 at our institution undergoing revision shoulder arthroplasty. From this group, we identified those who required a humeral window or longitudinal split to facilitate removal of a well-fixed component. Outcomes identified were intraoperative complications, postoperative complications, and rate of healing. Twenty-seven patients had a humeral window created to remove a well-fixed component. Of these, 19 were cemented components and 8 were fully textured, press-fitted components. Six intraoperative fractures were documented: 5 in the greater tuberosity and 1 in the distal humeral shaft. At most recent radiographic follow-up, 24/27 windows healed, 2 patients had limited inconclusive radiographic follow-up (1 and 2 months), and 1 did not have follow-up at our institution. Twenty-four patients underwent longitudinal osteotomy to remove a well-fixed component. There were 16 cemented components and 8 fully textured, press-fitted components. One patient had intraoperative fracture in the greater tuberosity. At most recent radiographic follow-up, 22/24 longitudinal splits healed, 1 had short follow-up (1½ months) with demonstrated signs of healing, and 1 did not have follow-up at our institution. In both groups, there were no cases of window malunion and no components developed clinical loosening. This study suggests humeral windows and longitudinal splits can facilitate removal of well-fixed humeral components with a high rate of union and a low rate of intraoperative and postoperative sequelae.

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98. Effects of Glenosphere Positioning on Impingement-Free Internal and External Rotation Following Reverse Total Shoulder Arthroplasty

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INTRODUCTION: While shoulder elevation can be reliably restored following reverse total shoulder arthroplasty (RTSA), patients may experience a loss of internal and external rotation. Several recent studies have investigated scapular notching and have made suggestions regarding glenosphere placement in order to minimize its occurrence. However, very few studies have looked at how changes in glenosphere placement in RTSA affect internal and external rotation. This is clinically important, since shoulder rotation in varying degrees of scaption (or elevation in the plan of the scapula) are needed to perform many essential activities of daily living. The purpose of this study was to determine the effect of glenosphere position on internal and external rotation range of motion at various degrees of scaption following RTSA. We hypothesized that alteration in glenosphere position will affect the amount of impingement-free internal and external rotation.

METHODS: CT scans of the scapula and humerus were obtained from seven cadaver specimens and 3-Dimensional (3D) reconstructions were created. A corresponding 3D RTSA model was created by laser scanning the baseplate, glenosphere, humeral stem, and bearing. The RTSA models were then virtually implanted into each specimen. The glenosphere position was determined in relation to the neutral position in 6 different settings medialization (5 mm), lateralization (10 mm), superior translation (6 mm), inferior translation (6 mm), superior tilt (20º), and inferior tilt (15º and 30º). The humerus in each virtual model was allowed to freely rotate at a fixed scaption angle until encountering bone-bone or bone-implant impingement (180º of limitation). Each model was tested at 0º, 20º, 40º, and 60º of scaption and the impingement-free internal and external rotation range of motion for each scaption angle was recorded.

RESULTS: At 0º scaption, only inferior translation, lateralization, and inferior tilt allowed any impingement-free motion in IR and ER. At mid ranges of scaption (20º and 40º) a predictable pattern was seen in which increased lateralization and inferior translation resulted in improved rotation. Supraphysiologic motion (>90º rotation) was seen consistently at 60˚ of scaption in internal rotation. Both superior and inferior tilt positions resulted in increased ROM in the mid-range of scaption. Acromial impingement was seen when the glenosphere was medialized, superiorly translated and with a superior tilt. Superior translation (6 mm) resulted in no rotation at 0º and 20º of scaption (both IR and ER).

CONCLUSION: Glenosphere position significantly affected humeral internal and external rotation after Reverse Total Shoulder Arthroplasty in our computer model. Inferior translation (6 mm) or lateralization (10 mm) appears to have the most beneficial effects to internal and external rotation of the shoulder. Inferior tilt (15° and 30°) of the glenosphere also improved overall arc of motion in IR and ER when compared to superior tilt and neutral positions. Superior translation (6 mm) and medialization (5 mm) of the glenosphere caused marked limitations in internal and external rotation due to scapular notching and acromial impingement.

99. Relationship of Scapular Neck Length to Scapular Notching After Reverse Total Shoulder Arthroplasty Using Plain Radiographs

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BACKGROUND: Scapular notching in reverse shoulder arthroplasty appears to be a multifactorial problem related to both implant and patient factors. There are well established guidelines for implant position. Recent cadaveric studies have illustrated anatomic factors that should be considered further. Scapular neck length and inferior glenoid tubercle morphology may be major factors in predicting scapular notching. The purpose of this study was to determine if scapular neck length, as measured on plain radiographs, could predict scapular notching, and allow for implant consideration prior to surgical intervention.

METHODS: We reviewed radiographs of patients from two institutions who had undergone reverse shoulder arthroplasty. The review period went back 3 years and included all reverse shoulder arthroplasties at least 12 months out from surgery. There had to be true anterior-posterior radiographs, both pre- and postoperative available, and there had to be “ideal” positioning of the glenosphere: at or below the inferior margin of the glenoid, and neutral or slight inferior tilt. Two independent surgeons reviewed the x-rays and measured the height of the glenoid articular surface, the length of the scapular neck, and the presence of notching.

RESULTS: In total, 64 radiographic sets were reviewed with 50 of them meeting inclusion criteria. Notching was present in 25 (50%) of the x-ray sets while notching was absent in the remaining 25. In the group that notching was present, the mean scapular neck length was 8.9 mm with a neck:surface ratio of 0.23. In the group absent of notching, the mean neck length was 12.1 mm with a neck:surface ratio of 0.32. Significance was reached with both scapular neck length and neck:surface ratio ($p=0.0012$ and 0.0006 respectively). Interobserver reliability as measured by a concordance correlation coefficient was found to be high with 0.87 for the neck length and 0.91 for the ratio.

CONCLUSIONS: We believe this study to be the first to evaluate scapular anatomy in relation to notching in reverse total shoulder arthroplasty and concomitantly showing a correlation. In our analysis of scapular neck length as well as the ratio of scapular neck length to glenoid articular height, we were able to reproducibly demonstrate with a high degree of significance that patient anatomy does play a role in the occurrence of notching. In light of the statistical significance in this study, surgeons may consider lateralizing the glenosphere in patients with a scapular neck length less than 9 mm measured on a true AP radiograph.

100. Second Generation Anatomic Total Shoulder Arthroplasty for Primary Osteoarthritis: Expanded Mid-Term Follow-Up

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INTRODUCTION: Second-generation anatomic total shoulder arthroplasty (TSA) components impart modular options for humeral head and stem sizes. This did not improve clinical outcomes when compared to first generation components. Presently, we aim to expand our analysis of these second-generation components in a larger series with longer follow-up, using a single implant.

METHODS: Between January 1997 and May 2001, 83 second-generation modular TSAs with a keeled, all-poly glenoid were performed for primary OA. Humeral head size was determined by intraoperative soft-tissue tension assessment and trialing. All operations were performed by one of the two senior authors. Of the shoulders reviewed, 75 shoulders in 70 patients had a minimum two year clinical follow-up. Outcome measures included pre- and postoperative pain, range of motion, and postoperative modified Neer score. Survivorship, free from revision for any cause, was assessed using a Kaplan Meier survival analysis.

RESULTS: Seventy-five TSAs, with a mean patient age of 70, were analyzed with a mean follow-up of 91 months. Of the surviving TSAs, pain scores decreased an average of 2.7 points on a 5 point scale. Abduction and external rotation increased in all patients by an average of 54º and 29º, respectively. There were a total of 37 excellent, 18 satisfactory, and 18 unsatisfactory results based on modified Neer scores. Seven shoulders required reoperation. Kaplan Meier analysis demonstrated a five-year survival of 98.8% (CI 96.2-100) and ten-year survival of 89.2% (CI 81-98.1). Radiographically, 8 glenoid components were noted to be at risk at the time of most recent follow-up.

DISCUSSION: With extended mid-term follow-up, second generation anatomic TSA demonstrates improvement in pain and range of motion in patients treated for primary OA. Survival analysis indicates an approximate 1% cumulative risk of reoperation per year at 10 years.

101. Functional Outcome and Complications After Total Shoulder Arthroplasty in the Obese Patient Population. A Prospective Study with Greater Than Two Years of Follow-Up

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INTRODUCTION: There is a high prevalence of obesity in the United States and the numbers are increasing. These patients comprise a significant portion of the shoulder arthroplasty patient population. There are several reports of outcomes in the literature on obesity patients after total knee or hip replacement; however, this data is lacking in the shoulder arthroplasty patient population. The purpose of this study is to compare the functional outcomes and complications of obese patients undergoing shoulder arthroplasty with the non-obese population.

METHODS: Between 2009 to 2010, 76 patients that had a primary total shoulder replacement were grouped according to their Body Mass Index (BMI) and followed prospectively for 2 years. The groups were divided as normal (BMI <25, N=26), overweight (25 to 30 BMI, N=25), and obese (>30 BMI, N=25). Preoperative demographics, age, comorbidities and postoperative complications were recorded. ASES, SF-36 Component (MC and PC) scores, and VAS (Pain) were evaluated at the 0 and 2 year time period. Statistical analyses were performed.

RESULTS: In the normal BMI group, average ASES scores improved from 38.4 +/- 15.5 (pre-operative) to 80.2 +/- 19.4 (2 year), SF-36 Physical Component (PC) scores improved from 38.3 +/- 6.5 (preoperative) to 53.7 +/- 11.3 (2 year), and VAS decreased from 62 to 12 (2 year). In the overweight BMI group, average ASES scores improved from 37.4 +/- 18.1 (preoperative) to 75.2 +/- 24.9 (2 year), SF-36 Physical Component (PC) scores improved from 36.1 +/- 8.0 (preoperative) to 39.8 +/- 12.2 (2 year), and VAS decreased from 68 to 18. In the obese BMI group, average ASES scores improved from 35.8 +/- 12.5 (preoperative) to 80.0 +/- 20.6 (2 year), SF-36 Physical Component (PC) scores improved from 36.3 +/- 8.4 (preoperative) to 40.7 +/- 12.4 (2 year), and VAS decreased from 66 to 11 (2 year). There was one deep infection in the overweight group that required a surgical irrigation and debridement.

DISCUSSION AND CONCLUSION: Shoulder arthroplasty in all three groups was associated with significant improvements in ASES scores and decrease in overall pain. Obese and overweight patients after TSA had less overall physical function improvements compared to the normal BMI group. Complications were minimal after TSA in all three patient groups.

102. Deltoid Parameters as Outcome Predictors Following Reverse Shoulder Arthroplasty

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INTRODUCTION: Reverse shoulder arthroplasty (RSA) allows the deltoid to substitute for the non-functioning rotator cuff; however, little investigation has determined specific deltoid factors correlated with RSA outcomes. The purpose of our investigation is to identify deltoid predictors of outcome following RSA utilizing an RSA outcomes registry.

MATERIALS AND METHODS: Patients undergoing RSA by a single fellowship-trained orthopedic surgeon and enrolled in a prospective RSA outcomes registry with diagnosis of irreparable rotator cuff tear, minimum two-year clinical and radiographic follow-up, preoperative shoulder MRI, and limited to a single prosthesis were evaluated. For those patients (n=15), cross-sectional area of the anterior deltoid, middle deltoid, and posterior deltoid were measured on axial T2-MRI. Fatty atrophy of the deltoid, supraspinatus, infraspinatus, teres minor, and subscapularis were graded on sagittal T1-MRI by a fellowship-trained musculoskeletal radiologist with the 5-point Fuchs scale. Acromiohumeral distance (AHD) was measured utilizing plain preoperative and postoperative radiographs. Patients were assessed clinically by a trained clinical research nurse. Correlation of deltoid cross sectional area and fatty atrophy with outcomes measures was analyzed with a Spearman rank correlation coefficient (ρ) with significance at $P<0.05$.

RESULTS: The anterior deltoid cross-sectional area positively correlated with CS ($\rho=.622$, $P=0.013$), ASES total ($\rho=0.714$, $P=0.002$) and ADL scores ($\rho=0.730$, $P=0.002$), SSV ($\rho=0.631$, $P=.011$), and strength in external rotation ($\rho=0.598$, $P=0.018$) at most recent follow-up. Neither grade of fatty atrophy of the rotator cuff nor change in acromiohumeral distance correlated to any clinical outcome data.

CONCLUSIONS: Deltoid size impacts functional outcomes following RSA. Of the three deltoid divisions, increased anterior deltoid size appears to correlate most significantly with positive outcome measures. Further investigation is needed to optimize these deltoid parameters and investigate others.

103. Shoulder Arthroplasty for Rheumatoid Arthritis: 303 Consecutive Cases with Minimum 5-Year Follow-Up

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INTRODUCTION: Two-year follow-up data on a cohort of 303 patients with shoulder arthroplasty for rheumatoid arthritis between January 1, 1976, and December 31, 1991, has previously been published. Longer term outcomes of these patients, especially when comparing hemiarthroplasty to total shoulder arthroplasty, would be valuable.

METHODS: This study is an update of 159 total shoulder arthroplasties and 89 hemiarthroplasties with complete preoperative evaluation, operative records, and minimum 5-year follow-up (mean 12.7 years) or follow-up until revision. In addition, a survival analysis of all 303 shoulders was completed (195 total shoulder arthroplasties and 108 hemiarthroplasties).

RESULTS: Among both hemiarthroplasty and total shoulder arthroplasty, there were significant long-term changes ($p<0.001$) for pain relief (mean [sd]=2.4 [1.4] and 2.7 [1.2]), improvement in active abduction (mean [sd]=32 [40] and 36 [51]), and improvement in external rotation (mean [sd]=18 [32] and 18 [35]). There was not a significant difference in pain improvement ($p=0.53$), (mean [sd]=2.6 [1.3] and 2.8 [1.3]) or abduction ($p=0.50$), (mean [sd]=36 [38] and 32 [48]) when comparing hemiarthroplasty and total shoulder arthroplasty for patients with a thin or torn rotator cuff.

In patients with an intact rotator cuff, a significant improvement in pain ($p=0.03$), (mean [sd]=1.8 [1.5] and 2.6 [1.2]) and a borderline significant improvement in abduction ($p=0.06$), (mean [sd]=22 [43] and 44 [54]) were observed when comparing hemiarthroplasty and total shoulder arthroplasty.

Among all 303 shoulders, the survivorship free of revision was 91.3% (95% CI: 87.7,94.9) at 10 years and 86.0% (95% CI: 79.4,92.6) at 20 years. Among patients with an intact rotator cuff, the survivorship free of revision was significantly lower for hemiarthroplasties ($p=0.04$), 75.8% (95% CI: 60.3,94.7) at 10 years, and 75.8% (95% CI: 51.0,94.7) at 20 years; and for total shoulder arthroplasty was 96.7% (95% CI: 91.4,100) at 10 years and 87.5% (95% CI: 68.5,100) at 20 years.

DISCUSSION AND CONCLUSION: The data from this study indicate that with long-term follow-up, there is marked long-term pain relief and improvement in abduction with shoulder arthroplasty for rheumatoid arthritis. Among patients with an intact rotator cuff, total shoulder arthroplasty appears to be the preferred procedure for pain relief, improvement in abduction, and lower risk of revision surgery.

104. Are 2.7 mm Recon Plates Stable Enough for Anteroinferior Plating of Displaced Midshaft Clavicle Fractures?

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INTRODUCTION: The purpose of this study was to elucidate the rate of implant failure comparing 2.7 mm DC plates compared to 2.7 mm Recon plates for anteroinferior plating in midshaft clavicle fractures.

METHODS: Between 2002 and 2010, 180 consecutive skeletally mature patients with 181 midshaft clavicle fractures underwent open reduction and internal plate fixation in one Level I trauma center, were followed in a single private practice, and retrospectively evaluated. Excluded patients were related to pathological fracture (1), death (1), initial nonoperative treatment (1), superior plating (8), and incomplete data (20). Therefore, the final study group consisted of 150 clavicle fractures in 149 patients. The distribution between the two plate types was almost equal: 80 DC plates (53.3%) and 70 Recon plates (46.7%). Fractures were classified according to the OTA/AO classification. Patients were evaluated clinically and radiographically at regular intervals of 2, 6, and 12 weeks.

RESULTS: The majority (67.1%) of the patients were male. Mean age was 41 years. The body mass index (BMI) averaged 26.3 kg/m2. Mean follow-up was 9.5 months (3-54). Fractures were classified as 15B1 70 (46.7%), 15B2 62 (41.3%), and 15B3 17 (11.3%). Median plate length was 12 holes (5-16). Median number of screws inserted was 8 (4-12). Lag screws were used in 80 (53.3%). Average working length was 1.5 holes. Fractures healed in 97.3%. No infections were recorded. Four patients developed a nonunion (2.7%), and 3 fractures (2.0%) healed as malunions. Malunion formation was related to higher BMI ($p=0.008$). No differences were found for nonunion or malunion regarding plate type, plate length, or working length. Hardware failure occurred in six fractures (4.0%). Failure rate was 7.1% in Recon plate constructs (5/70) and 1.3% in DC plates (1/80) ($\chi^2=0.066$).

CONCLUSION: Hardware failure in anteroinferior plating is low. Nonunion and hardware failure rates are low when following modern surgical techniques with longer plates. The increased rate of hardware failure led us to a recent change in surgical technique avoiding Recon plates for clavicle osteosynthesis. Further biomechanical studies are warranted.

105. Shoulder Arthroplasty for the Treatment of Post-Infectious Glenohumeral Arthritis: An Update

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BACKGROUND: Aside from our previous study, no studies on shoulder arthroplasty after a previous infection of the shoulder have been published, as far as we know. The purpose of this study was to evaluate the rates of reinfection and the clinical results after shoulder arthroplasty for the treatment of post-infectious glenohumeral arthritis.

METHODS: Between 1977 and 2009, 23 patients with a history of infection of the shoulder that resulted in severe glenohumeral arthritis underwent shoulder arthroplasty at our institution. All shoulders were followed for a minimum of 2 years (mean, 8.3 years) or until the time of revision surgery. Complications, clinical results (pain, satisfaction, and range of motion), and radiographic results were documented at the time of the latest follow-up.

RESULTS: Two patients in this study had a known reinfection at the time of the latest follow-up. One patient had a positive culture at time of re-implantation and one had a resection for coagulase negative Staphylococcus aureus. Three other patients underwent revision for loosening. One other patient has been treated with chronic suppression antibiotics due to a positive culture at the time of the shoulder arthroplasty. Overall pain scores improved from 4.5 to 2.1 points after implantation of a prosthesis. Twenty-one of the 23 patients had no pain or mild or moderate pain after vigorous activity. The mean shoulder abduction improved from 62° to 110°, and the mean external rotation improved from 14° to 47°. Subjectively, only 14 of the 23 patients rated the result as much better or better.

CONCLUSION: Shoulder arthroplasty for the treatment of the sequelae of an infected shoulder can be performed with a low risk of reinfection. While overall pain and motion can be expected to improve, unsatisfactory clinical results that are related to the destructive effects of the initial infection are not uncommon.

106. Flexible Insertion and Final Rigid, Locked Intramedullary Fixation for Mid-Diaphyseal Clavicle Fractures with a Novel Device

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INTRODUCTION: The purpose of this study was to evaluate the preliminary clinical and radiographic results of a novel intramedullary (IM) device that permits flexible insertion and subsequent rigid, locked fixation for mid-diaphyseal clavicle fractures.

METHODS: A retrospective chart review was performed for all patients surgically treated with a novel IM device for an acute or chronic mid-diaphyseal clavicle fracture from October 2010 to December 2012. Primary outcome measure was union. Secondary outcome measures included visual analogue pain scores (VAS), range of motion (ROM), modified Neer scores, and complications.

RESULTS: Eight patients (5 men and 3 women) with a mean age of 30 years (range: 16 to 68 years) were included into the study with a mean follow-up of 4.5 months (Range: 2 to 9 months). Fractures included OTA 15.B1 (n=4), OTA 15.B2 (n=1), and OTA 15.B3 (n=3). Fracture union was noted in 7 of 8 patients at a mean of 3.3 months (range: 2 to 7 months) from surgery with one case of pending union. Pain was rated at 0/10 with “excellent” modified Neer scores in all eight patients at the time of most recent follow-up. There were no hardware failures, tenderness at the fracture site, cosmetic complaints, or infections. Incisional paresthesia was present in two patients.

CONCLUSIONS: A novel IM device that allows flexible insertion and final rigid, locked fixation for mid-diaphyseal clavicle fractures can result in high rates of union and excellent clinical and functional results in this preliminary series.

107. Does Anteroinferior Fixation of Midshaft Clavicle Fractures Have Lower Rates of Hardware Removal or Complications?

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INTRODUCTION: The primary objective of this study was to compare hardware removal rates with plates positioned superiorly to those positioned anteroinferiorly. Secondary objectives were to report any significant correlation between hardware removal, complications demographics, fracture characteristics, or implant types as well as superior versus anteroinferior plating.

METHODS: A retrospective study of 328 consecutive midshaft clavicle fractures treated by ORIF at three Level I trauma centers between 2006-2010 was performed. Electronic medical records and radiographic studies were reviewed to collect patient demographics, injury characteristics, operative techniques, and outcomes.

RESULTS: Hardware removal was performed on 42/328 (12.8%) patients. Analysis comparing patients requiring HWR to those not requiring, revealed females had a statistically higher rate of HWR ($P<0.001$). Of the 328 fractures, 205 (62.5%) fractures were plated anteroinferiorly and 123 (37.5%) superiorly. Surprisingly, comparative analysis of anteroinferior plating and superior plating showed that hardware removal rates were higher for the anteroinferior group (15.3% vs. 10.7%); however, this difference was not significant ($p=0.3$). Of the 328 fractures, the rates of hardware failure, nonunion, and infection were 2.7%, 1.5%, and 0.9% respectively. Plate location, type, and size did not have an effect on nonunion or infection rate; however, there was a higher rate of hardware failure in patients with 2.7 mm plates compared to 3.5 mm (5.4% vs. 1.1%) ($p<0.05$). Additionally, reconstruction plates demonstrated a higher rate of failure compared to DC/LCDC plates (7.1% vs. 1.8%) ($p<0.05$).

CONCLUSION: This study does not provide compelling evidence that either plate location is superior in terms of reducing rates of hardware removal or complications. Risk factors for failure of fixation include the use of reconstruction or 2.7 mm plates as opposed to lcdc or precontoured plates or 3.5 plates.

108. The Impact of Tunnels and Biotenodesis Screws on Clavicle Fracture: A Biomechanical Study of Varying Coracoclavicular Ligament Reconstruction Techniques

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INTRODUCTION: Reconstruction of the coracoclavicular ligaments has been described using no tunnels, one tunnel, or two tunnels in the distal clavicle. Biotenodesis screws are often used to supplement graft fixation in the clavicle. While techniques utilizing two tunnels provide more anatomic reconstruction of the coracoclavicular ligaments, case reports exist that describe clavicle fracture after coracoclavicular ligament reconstruction utilizing tunnels in the distal clavicle. The purpose of this study is to compare the load to failure of distal clavicles with no tunnels, one tunnel or two tunnels, and to evaluate the effect that inserting biotenodesis screws in the tunnels has on load to failure.

MATERIALS AND METHODS: Fifty right sawbone clavicles (Sawbones Worldwide Model 1020-20) were obtained and divided into 5 groups (n=10): Group 1 – normal clavicle; Group 2 – one tunnel, no biotenodesis screw; Group 3 – two tunnels, no biotenodesis screws; Group 4 – one tunnel with biotenodesis screw; Group 5 – two tunnels with two biotenodesis screws. Tunnels were created using a 5 mm diameter reamer, and 5.5 mm x 10 mm biotenodesis screws were utilized. A four point bending load was applied to the prepared distal clavicles. Load to failure was noted for each specimen.

RESULTS: The load to failure in clavicles without tunnels was significantly higher (259.5±33 lbs) than in all other groups ($p<0.0005$). No statistical differences were noted between groups 2, 3, 4, or 5. Load to failure was not statistically different in clavicles with one or two tunnels. In addition, the use of biotenodesis screw in the tunnels did not affect the force required to fracture.

DISCUSSION: The use of tunnels in the clavicle for coracoclavicular ligament reconstruction significantly reduces the force required to fracture the distal clavicle. The addition of biotenodesis screws does not appear to significantly increase the strength of the clavicle in this construct. These findings may influence the surgical technique utilized for coracoclavicular ligament reconstruction.

109. Quantitative Anatomy of the Acromioclavicular Joint and Adjacent Structures on Magnetic Resonance Imaging

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BACKGROUND: The Rockwood classification is widely used to describe injuries to the acromioclavicular joint (ACJ), and the radiographic findings are utilized as indirect markers of injury to the ACJ capsule/ligaments and coracoclavicular (CC) ligaments. Subtle pathology of this region of the shoulder is not always identified using standard radiography; magnetic resonance imaging (MRI) has been advocated to allow direct identification of injury to these tissues.

PURPOSE: The purpose of this study was to quantitatively characterize anatomic structures of the ACJ using MRI to improve our understanding of normal bony and soft tissue anatomy of this region.

METHODS: This is a retrospective review and was approved by the Institution Review Board. The imaging database was queried for patients with an MRI of the shoulder, age 16-35, and without a diagnosis of an ACJ separation. Patient demographics included age, sex, and laterality. Standard sagittal, coronal, and axial MRI slices of the shoulder were reviewed and measurements were obtained using embedded tools in the Picture Archiving and Communication System. ACJ dimensions, CC distance, CC ligament width, and clavicle thickness at CC ligament origin were recorded. Patients with any signs of injury to the ACJ or CC ligaments were excluded.

RESULTS: Forty patients were included. The average age was 25 (range 16-35); there were 26 males and 14 females, and 24 right and 16 left shoulders. The following average dimensions were found: ACJ width 5.3 mm (range 3-9), CC distance 11.1 mm (range 4-18), CC ligament width 3.4 mm (range 2-6), and clavicle thickness at CC ligament origin 10.3 mm (range 7-14).

DISCUSSION: This study presents the first quantitative characterization of normal ACJ and surrounding structural anatomy using MRI and provides a useful baseline for these dimensions. The average ACJ width on MRI was 5.3 mm and the average CC ligament distance was 11.1 mm. Improved initial diagnosis may lead to improved ACJ injury classification and appropriate treatment.

MAOA BREAKOUT SESSION #8
JOINT
April 19, 2013

110. Contribution of the Acetabular Labrum to Hip Joint Stability: A Quantitative Analysis Using a Dynamic Three-Dimensional Robot Model

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INTRODUCTION: The acetabular labrum is an essential stabilizer of the hip joint, imparting its greatest effect in extreme joint positions where the femoral head is at risk of subluxation and dislocation. However, its stabilizing value is difficult to quantify. We introduce a novel method to objectively measure the labrum's contribution to hip joint stability.

METHODS: Five fresh-frozen human cadaveric hips without labral tears were mounted to a six-degree-of-freedom robotic manipulator and studied in two distinct joint positions provocative for either anterior or posterior dislocation. Dislocation potential tests were run in 15° intervals, or sweep planes, about the face of the acetabulum. For each interval, a 100N force vector was applied medially and swept laterally until dislocation occurred. Three-dimensional kinematic data from conditions with and without labrum were quantified using the stability index, which is the percentage of all directions a constant force can be applied within a given sweep plane while maintaining a stable joint.

RESULTS: Global stability indices, considering all sweep planes, were significantly greater with labrum intact than after total labrectomy for both anterior ($p=0.02$) and posterior ($p<0.001$) provocative positions. Regional stability indices, based upon the expected range of dislocation for each provocative position, were also significantly greater and of slightly larger magnitude for the intact condition than after total labrectomy ($p<0.001$).

CONCLUSION: This is the first known application of a six-degree-of-freedom robot to recreate mechanical hip impingement and dislocation to quantify the role of the labrum in hip stability. In the extreme positions, the labrum imparts significant overall mechanical resistance to hip dislocation. Regional stability contributions appear to vary with joint orientation. Although this model does not replicate in vivo conditions, it provides insight into the labrum's role in preventing dislocation through a new, objective measure of stability. Regional analysis might offer additional clinical utility by focusing on where the femoral head would most likely engage the labrum for a given joint position.

111. Decreased Manipulation Rate with Second Generation Medial Pivot Knee

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INTRODUCTION: The medial pivot knee in senior surgeon's practice has a published manipulation rate of 3.5%. The second generation medial pivot knee has design criteria to increase knee flexion.

HYPOTHESIS: We hypothesized that these design features would decrease the manipulation rate using same criteria for manipulation.

MATERIALS AND METHODS: A retrospective review of prospectively collected data was performed for all patients receiving the second generation medial pivot EVOLUTION knee replacement in a primary setting. Rate of manipulation was collected and compared to our historical, published controls with ADVANCE first generation medial pivot knee.

RESULTS: Of 592 patients receiving second generation implant, 7 (1.1%) required manipulation under anesthesia. This was compared to 10 of 289 (3.5%) of patients receiving the first generation of medial pivot implant and requiring manipulation. The difference is statistically significant ($p<.05$).

CONCLUSION: Design features of the second generation medial pivot knee have decreased the manipulation rate.

SIGNIFICANCE: These design feature changes may apply to future designs of other implant types also.

112. Preoperative MRI Underestimates Articular Cartilage Defect Size Compared to Arthroscopy

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MRI is widely used to preoperatively visualize articular cartilage damage. However, the reliability of MRI sizing of cartilage defects is not well understood. It was hypothesized that MRI estimation of knee cartilage lesion size would produce measurements that were equivalent to those made during arthroscopic knee surgery. Seventy-seven patients (age 38±10.7 years) that met inclusion criteria underwent a preoperative knee MRI of at least 1.5T at the same institution within one year (median one month) of arthroscopic knee surgery for a high-grade cartilage defect. Post-debridement defect sizes were obtained from intraoperative surgery notes and compared with retrospective MRI estimates. A total of 92 cartilage defects were analyzed with an average of 1.2 high-grade defects per knee, and average post-debridement defect area of 2.99 cm^2 (SD=2.63) per lesion. Preoperative MRI analysis predicted a lesion area that was an average of 1.04 cm^2 (SD=1.67) smaller than measurements made during arthroscopy ($p<0.0001$). In 74% of the lesions analyzed, defect size was larger upon arthroscopic visualization than was predicted by MRI sizing. On average, MRI underestimated defect area by 70% compared to arthroscopy. By compartment, MRI underestimated defect size in the medial femoral condyle ($p=0.0002$), lateral femoral condyle ($p=0.0276$), and trochlea ($p=0.0014$), but not the patella ($p=0.5352$). Thus, MRI underestimates chondral defect size compared to arthroscopic visualization after debridement of surrounding unstable, fissured cartilage. As lesion size is a crucial factor in the selection of an optimal repair strategy, patients should receive appropriate preoperative counseling about the importance of lesion size that includes a discussion about the multiple options available depending on intraoperative findings. Prior to arthroscopy, surgeons should consider treatment strategies that are appropriate for a larger defect than predicted by preoperative MRI. Finally, new imaging modalities are necessary to improve the reliability of MRI as a preoperative tool for the clinical assessment of articular cartilage damage.

113. Early Clinical and Radiographic Outcomes of Combined Hip Arthroscopy and Periacetabular Osteotomy

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INTRODUCTION: The Bernese periacetabular osteotomy (PAO) addresses extra-articular deformity correction by redirecting the acetabulum into an improved mechanical position, but does not address the concomitant intra-articular pathology of acetabular dysplasia. There is limited information on the combination of hip arthroscopy with PAO for treating symptomatic acetabular dysplasia and associated intra-articular abnormalities. The purpose of this study was to report the early clinical and radiographic outcomes of combined hip arthroscopy with PAO compared to PAO combined with open arthrotomy and femoral head-neck osteochondroplasty.

METHODS: We retrospectively reviewed 42 patients (43 hips) who underwent hip arthroscopy combined with PAO (HS-PAO) and compared this to a control group of 37 patients (37 hips) who underwent PAO combined with an open arthrotomy and femoral head-neck osteochondroplasty. The average clinical follow-up of the HS-PAO group was 25.7 months (range, 7-52 months) and the control group was 42.1 months (range, 23-85 months). We used the Harris Hip Score to evaluate hip function. To evaluate clinical performance, we used the SF-12 and WOMAC scores. Radiographically, we calculated lateral center-edge angle (LCEA), acetabular index, anterior center-edge angle (ACEA), and Tönnis osteoarthritis grade. Perioperative complications were graded and compared between groups.

RESULTS: The patient demographics were similar between groups. Both groups saw major improvements in Harris Hip Score, SF-12 physical scores, WOMAC pain scores, and WOMAC function scores. We observed an increase in the LCEA, decrease in the acetabular index, and increase in the ACEA in each group. There were two grade III complications in each group and a total of six grade I complications.

CONCLUSION: At short-term follow-up, hip arthroscopy with PAO shows equivalent clinical and radiographic outcomes without increase in major complications versus PAO with femoral head-neck osteochondroplasty.

114. Can Patients Return to High Level Activity After Open Hip Preservation Surgery with Surgical Hip Dislocation and/or Bernese Periacetabular Osteotomy?

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INTRODUCTION: Surgical hip dislocation (SHD) and periacetabular osteotomy (PAO) are well described interventions for femoroacetabular impingement and acetabular dysplasia, respectively. While both procedures can reduce pain and restore anatomy, patient return to high-level activity remains controversial. The goal of this study is to evaluate the ability of highly active patients to return to preoperative activity levels following open hip preservation surgery.

METHODS: This is a retrospective review of highly active patients treated with SHD and/or PAO between May 2007 and April 2011. Included patients had preoperative UCLA activity levels ≥ 7. Patient demographics, operative data, and outcome scores (Harris Hip and HOOS) were collected. Postoperative UCLA activity score and information regarding activity and satisfaction were obtained via telephone survey.

RESULTS: This study included 55 patients (59 hips), 26 males and 29 females, whose average age was 23.9. Mean follow-up was 33 months. Surgical hip dislocation was performed in 34%, PAO in 60%, and combined SHD/PAO in 6% of patients. Harris Hip scores improved significantly from 63.7 to 82.6 ($p<0.05$); HOOS sports and recreation scores also improved (52.7 to 78.8, $p<0.05$). There was no difference in pre- and postoperative UCLA score (9.96 vs. 9.05, $p=0.09$). Seventy-three percent of patients reported an increase (57%) or no change (15%) in postoperative activity. Decreased pain was the most cited reason for increase in postoperative activity. Of 15 patients (27%) reporting a decrease in activity, continued hip pain was the limiting factor in 5 (9.0%). Ninety-five percent of patients were satisfied with surgery. There was no significant difference between the type of open hip preservation procedure (PAO versus SHD) and the likelihood of change in postoperative activity level.

CONCLUSION: In the majority of highly active patients (91%), return to pre-surgical or desired activity level was not impaired by open hip preservation surgery.

115. Periacetabular Osteotomy After Failed Treatment with Hip Arthroscopy

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INTRODUCTION: Treatment of symptomatic hip dysplasia has focused on corrective osteotomy surgery, while hip arthroscopy remains controversial. Improved understanding of the patient population that fails to improve with hip arthroscopy alone is important to guide future treatment of hip dysplasia. The purpose of this study was to define the patient population and clinical presentation of patients that fail hip arthroscopy, present with persistent symptoms, and are treated with periacetabular osteotomy (PAO).

METHODS: A prospective, multi-center database of over 2,250 hip preservation procedures was searched to identify patients who underwent a periacetabular osteotomy (PAO) following a failed hip arthroscopy. Patients were analyzed by preoperative radiographs, clinical outcome scores, and intraoperative disease patterns.

RESULTS: Thirty-one patients (31 hips) who underwent a PAO after failing a previous hip arthroscopy were identified. All patients were diagnosed as having acetabular dysplasia. Female patients represented 87% of the patients. The average age was 26.6 years and average BMI was 24.2. All patients had a previous hip arthroscopy, which was performed on average two years and one month prior to the PAO. Thirty-six percent of the patients underwent two arthroscopies prior to PAO. Of the patients that had full descriptions of the prior arthroscopy (N=23), the most common procedures included: labral debridement (52%), femoral osteochondroplasty (30%), and labral repair (26%). Labral abnormalities and acetabular chondral disease were noted in 61% and 26%, respectively, of patients who had either an arthrotomy or arthroscopy performed at the time of PAO (N=23). The average modified Harris Hip Score was 52.1, WOMAC 42.8, and UCLA 5.3 prior to PAO.

DISCUSSION AND CONCLUSION: Failed hip arthroscopy and the need for PAO is most commonly observed in young female patients with mild to moderate acetabular dysplasia. These patients usually present approximately two years after arthroscopy with persistent/ recurrent hip symptoms and major functional limitations. At revision surgery, labral and articular cartilage abnormalities are common.

116. Periacetabular Osteotomy Successful at Mid-Term for Treating Mild Hip Dysplasia

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INTRODUCTION: With the advent of hip arthroscopy, young hip surgeons are often faced with the decision to either perform arthroscopic surgery in hips with mild hip dysplasia (DDH) or to treat the underlying structural abnormality with a periacetabular osteotomy (PAO). The result of PAO in this group is not known and should be compared to the results of arthroscopic surgery increasingly done in this group. We, therefore, report the results of PAOs in patients with mild DDH and compare those to hips with more severe forms of DDH.

METHOD: From January 1996 to May 2009, 299 hips in 268 patients underwent PAO at one institution. The average age of the cohort was 31 years, and 85% were female. Nineteen hips with lateral center edge (LCE) angle from 18-25º and a Tönnis angle (TA) between 10-15° were considered to have mild hip dysplasia. This group (Group 1) was compared to the rest of the cohort (Group 2). The mean clinical follow for both groups was 53 months.

RESULTS: There was no significant difference in demographic variables between the groups. One hip in Group 1 (overcorrected) required a THA compared to 15 in Group 2. In Group 1, the 3-year PAO survival was 100% (95% CI: [100.0, 100.0]), 5-year was 100% (95% CI: [100.0, 100.0]), and 10-year was 86% (95% CI: [63.3, 100.0]). The corresponding rates for hips in Group 2 at 3, 5, and 10 years, respectively, were 99% (95% CI: [96.7, 100.0]), 95% (95% CI: [91.5, 99.6]), and 81% (95% CI: [71.9, 90.4]). Surgical correction resulted in significant improvements in all radiographic measurements consistent with hip dysplasia in both groups. The Harris Hip Score improved significantly in both groups (Group 1: 52 to 97, $p<0.001$) (Group 2: 66 to 89, $p<0.001$).

CONCLUSION: PAO in mild DDH provides predictable improvements in pain, function, and more durable results, providing overcorrection does not occur, when compared to hips with more severe forms of dysplasia. This data should be used to compare the results of arthroscopic surgery performed in mildly dysplastic hips.

117. Is Combined Surgical Hip Dislocation and Bernese Periacetabular Osteotomy a Safe Procedure?

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INTRODUCTION: Surgical hip dislocation (SHD) and periacetabular osteotomy (PAO) are hip preservation techniques utilized for the treatment of femoroacetabular impingement and acetabular dysplasia. Uncommonly, severe pre-arthritic hip deformities require a combined SHD and PAO, yet the morbidity of performing both procedures in a single stage has not been defined. The purpose of this study is to define the incidence of postoperative complications when a combined SHD and PAO are performed to treat complex hip deformities.

METHODS: This is a retrospective review of patients who underwent combined SHD and PAO. Complications were graded as follows: Grade I, no deviation from routine postoperative care; Grade II, outpatient intervention only; Grade III, inpatient intervention including surgical management; Grade IV, long-term morbidity or loss of the joint; and Grade V, death.

RESULTS: Twenty patients (20 hips) treated with a combined SHD/PAO were identified. There were 13 females. The average age was 21 years and average follow-up was 19 months. All hips had complex deformity of the acetabulum and proximal femur and 7 had undergone previous reconstructive surgery. Additional procedures included labral repair/debridement (16), trochanteric advancement (14), and relative femoral neck lengthening (17). There were 2 (10%) Grade II complications (one superficial wound infection requiring antibiotics and one delayed union of the trochanteric osteotomy). There were 2 (10%) Grade III complications (two post-operative infections requiring operative debridement). One patient suffered a postoperative infection and severe heterotopic ossification and ultimately required total hip arthroplasty (Grade IV complication). There were no major neurovascular injuries, osteonecrosis, fractures, or nonunions. After exclusion of minor Grade I or II complications, the overall complication rate was 15%.

CONCLUSION: Treatment of patients with complex, concomitant deformity of the proximal femur and acetabulum can be safely managed with combined SHD and PAO.

118. Patient Characteristics Affect Anatomic Location of the Femoral Artery About the Hip

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Injury to the femoral neurovascular structures is a risk of anterior acetabular retractor placement during total hip arthroplasty (THA). However, a paucity of data exists regarding the anatomic course of these critical structures in this area. This study attempts to define the location and variability of the femoral artery (FA) as it relates to the acetabulum. Hip MRIs from 100 consecutive adult patients were retrospectively reviewed. On axial images, location of the FA was measured at three locations about the acetabulum: level of the dome, superior iliopectineal (IP) ridge, and inferior IP ridge. Distance between FA and the lateral-most aspect of the medial wall was recorded in anterior-posterior (AP), medial-lateral (ML), and vector (V) directions. Statistical analysis utilized Student's t-test and ANOVA. Male to female ratio was 1:1.8. Mean patient age was 44.7 years (range 18-83). Mean height and weight were 1.69 m (range 1.31-1.98) and 79.7 kg (range 47.8-136.1), respectively. Sixty-seven percent of patients were African-American, 16% non-Hispanic Caucasian, 14% Hispanic, and 3% Asian. At the level of the acetabular dome, mean AP distance to FA was 22.1 mm (range 10.7-36.9), ML was 33.2 mm (21.6-48.3), and V was 40.1 mm (range 27.3-59.0). At the superior IP ridge, mean AP distance was 14.9 mm (range 4.7-25.0), ML was 7.3 mm (-5.9-31.0), and V was 21.6 mm (range 12.5-43.7). At the inferior IP ridge, mean AP distance was 17.0 mm (range 4.3-27.1), ML was 0.3 mm (-13.8-11.7), and V was 20.5 mm (range 11.4-31.9). Statistically significant ($p<.05$) decreases in mean AP, ML, and/or V distance were found for those weighing <75 kg, shorter than 1.7 m, female, or ≥ 45 years old. At the superior and inferior IP ridge, the FA was significantly ($p<0.05$) closer to the medial wall in Hispanics. In conclusion, the course of the FA is variable, but can dangerously approach the medical wall of the acetabulum, particularly at the inferior IP. Its location demonstrates variability depending on patient weight, height, gender, and age, with closest values found in patients that are <75 kg, shorter than 1.7 m, female, and ≥ 45 years old. Ethnicity also affects the location of the FA, with closest values found in Hispanics.

119. Osteoporotic Distal Femur Fractures Treated with Modular Oncologic Replacement Prostheses

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Comminuted distal femur fractures in the elderly remain a complex problem to manage. Non-union and prolonged immobilization in this patient population results in significant disability. While internal fixation remains the mainstay for non-comminuted distal femur injuries, when extensive comminution or bone loss is present, distal femur replacement may provide optimal management. This study evaluates the treatment of osteoporotic comminuted fractures of the distal femur in patients undergoing replacement with a modular oncologic hinge system. The study group includes 52 patients ranging in age from 65-91 years of age who have undergone distal femur replacement by a single surgeon. The patients were divided into three subgroups: (1) 18 acute distal femur fractures, (2) 12 nonunion or failed fixation of a distal femur fracture, and (3) 22 periprosthetic femur fracture. Perioperative complications, blood loss, length of hospitalization, and functional/ambulatory outcome were recorded and evaluated. The GMRS distal femur replacement was used in all cases. All components were cemented. Patients were full weightbearing without restrictions immediately postoperative. The average blood loss was 450 cc (200-850 cc), and the length of hospitalization ranged from 3-14 days (average stay 5.1 days). Thirty-nine of 52 patients presented with other injuries that were treated surgically and may have contributed to the length of hospitalization. Twenty-four perioperative complications were noted in 21 patients. This included pneumonia, DVT, myocardial infarction, renal insufficiency, cellulitis, deep infections, and PTE. All deep and superficial infections occurred in nonunion patient subgroup with prior internal fixation. Forty-six of 52 patients returned to independent ambulation at final follow. All thromboembolic events occurred in the acute fracture group while on anticoagulation treatment. Distal femur replacement is an acceptable option in the elderly patient population with a comminuted fracture that would benefit from immediate weightbearing. Caution should be used in nonunion patients with prior internal fixation and all should be cultured intraoperatively.

120. Effects of Corticosteroid Injection on Systemic Glucose Levels in Diabetic and Non-Diabetic Patients

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INTRODUCTION: Intra-articular and other soft tissue injections with corticosteroids are commonly used to treat painful joints secondary to many conditions. While the steroid exerts its activity locally, it also has systemic effects. Of special concern are diabetic patients presenting for care of painful joints who can be at increased risk of altered blood sugar control following injection. Our study evaluated change in serum glucose level using a continuous glucometer monitoring system (CGMS) in diabetic versus non-diabetic patients.

METHODS: Patients presenting to the orthopedic clinic with shoulder or knee conditions who would benefit from intra-articular or soft-tissue injection of a corticosteroid were prospectively recruited for the study from September 2009 to January 2012. Our local Institutional Review Board approved the study.

All participants were consented and had a CGMS placed on day of recruitment (Day 1). Patients were asked to record finger-stick glucose measurements 3-4 times a day. Non-diabetic patients were instructed on the appropriate method of finger-stick measurement for serum glucose and provided with a glucometer. For diabetic patients, verification was made of a working glucometer, and a working glucometer was provided when needed. Patients returned to the clinic on Day 2 for assessment of hemoglobin A1C and received a corticosteroid injection as treatment for their condition. Patients then returned to the clinic on Day 4 or 5 for removal of CGMS.

RESULTS: Thirty diabetic and 30 non-diabetic patients were recruited for the study. Three patients did not have any data recorded by the CGMS, two from the non-diabetic and one from the diabetic group. Thus, 57 patients were included in the analysis. In the diabetic group, 19 shoulders were injected and 7 knees were injected. In the non-diabetic group, 19 shoulders and 9 knees were injected.

As expected, the mean glucose level was higher for diabetic patients compared to non-diabetic patients at pre-injection (147±42 and 112±20; $p<0.001$) and post-injection (185±34 and 123±20; $p<0.001$) time points. The mean percent glucose increase was greater for diabetic patients (31%±35% vs. 14%.±20%; $p=0.029$).

CONCLUSION: Diabetic patients experience worsened hyperglycemia following corticosteroid injection of the large joints. Non-diabetic patients also experience increased hyperglycemia following injection of large joints, though to a lesser degree.

121. Post-Surgical Inflammatory Neuropathy After Hip Surgery

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BACKGROUND: New weakness with pain or numbness following hip surgery is often attributed to mechanical factors (stretch, compression, contusion, or transection). This article focuses on post-hip surgery patients who presented with ipsilateral neuropathic leg symptoms after surgery with features suggesting the possibility of a non-mechanical cause. The objective of this review was to assess for an inflammatory etiology of a new ipsilateral lower limb neuropathy in post-hip surgery patients.

METHODS: We characterized the clinical, electrophysiological, radiological, and pathological features of the new ipsilateral neuropathy in post-hip surgery patients who have had a nerve biopsy.

RESULTS: Seven patients (8 hip surgeries) were identified who developed ipsilateral leg weakness within four weeks of surgery and subsequently underwent nerve biopsy. Three were men with a median age of 63 (range 18 to 75) years). All patients developed focal neuropathies (5 lumbosacral neuropathies and 2 sciatic) that typically presented with acute pain and weakness mimicking mechanical etiologies. Electrophysiology showed severe axonal damage. All nerve biopsies were abnormal showing inflammation in 7, ischemic injury in 7, and signs of microvasculitis in 6 of 7. All patients were treated with IV methylprednisolone. In six patients who had a longitudinal follow-up at a median of six months, all showed improvement of their neuropathy impairment score, median 25 to 16.5 at final follow-up.

CONCLUSION: In a subset of patients who presented after hip surgery with severe or progressive neuropathic symptoms disproportionate to the degree of expected mechanical injury, inflammatory, not mechanical, factors played a prominent etiological role. Identification of these patients through nerve biopsy may lead to improved outcome with the use of immunotherapy. In these patients, the inflammatory mechanism was ischemic injury to microvasculitis.

122. Six-Year Review on Efficacy of Preoperative Vena Cava Filters in Arthroplasty Patients at Risk for Pulmonary Embolism

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INTRODUCTION: Controversy exists between the American Academy of Chest Physicians and the American Academy of Orthopaedic Surgeons over the efficacy of preoperative inferior vena cava filters (IVCF) in knee and hip arthroplasty patients that are high risk for pulmonary embolism (PE).

METHODS: We retrospectively reviewed 5,813 primary or revision hip and knee arthroplasties performed from 2006 to 2011 by the same surgeon. Thirty-two patients had IVCFs placed the day of surgery. Records were reviewed for the 90-day postoperative period for thromboembolic events and all other complications. Patient's history of inherited thrombophilia, deep vein thrombosis (DVT), and PE as well as age, type of surgery, height, weight, and body mass index (BMI) were analyzed for increased risk of complications postoperatively when treated with IVCF.

RESULTS: Of the 32 patients, the male to female ratio was 1:1. The mean age was 68.8 years (± SD 10.3), and mean BMI was 31.1 (± SD 4.6). Five patients had inherited thrombophilias, 31 had prior DVT and/or PE, and 1 had remote history of thrombophlebitis. Postoperatively, 2 patients had one or more proximal DVTs, 2 had distal DVTs only, and 2 had proximal and distal DVTs. No patients had a PE, but one had low oxygen saturation and tachycardia concerning for PE. Workup, including CT scan with PE protocol, revealed bilateral pleural effusions and no PE. One patient had a non-hemorrhagic stroke on the evening of surgery. Venous ultrasound (U/S) of this patient showed no DVT in the lower extremities. No significant statistical differences between patients that did or did not have DVT postoperatively were determined for all characteristics ($p>0.05$). However, patients that had DVT postoperatively had a higher mean BMI.

CONCLUSION: No patients were found to have a PE, and only one patient at high risk for PE treated preoperatively with IVCF had a major vascular event. This patient had a non-hemorrhagic stroke, but venous ultrasound did not show a source of embolus in the lower extremities of the patient. Our experience has shown that preoperative IVCFs are safe and efficacious in prevention of PE in high-risk patients.

MAOA BREAKOUT SESSION #9
PEDIATRICS
April 19, 2013

123. Physeal Gene Expression and Structure from Different Anatomic Regions in Two Species

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William J. Landis, Ph.D.	Akron, OH
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Melanie A. Morscher, B.S.	Akron, OH
Richard Steiner, Ph.D.	Akron, OH
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INTRODUCTION: Control tissue in the study of various orthopedic pathologies is difficult to obtain and equivalent biopsies from other anatomic sites have been utilized most frequently in previous work. In their particular investigations, physes from different anatomic regions were subject to dissimilar mechanical forces and produced disproportionate longitudinal bone growth. In this context, it is imperative that the physes from the separate anatomic regions be as similar as possible as part of the experimental design. The purpose of this study is to compare gene expression and structure in normal physes from different anatomical regions in a single species so as to establish whether such physes can be utilized as equivalent controls.

METHODS: Thirteen female New Zealand white rabbits (five 15-week-olds and eight 19-week-olds) and two 25-week-old male Sinclair miniature swine were euthanized and physes harvested from their proximal femurs, distal femurs, and proximal tibiae. The harvested physes were divided into portions for histological and quantitative reverse transcription-polymerase chain reaction (QRT-PCR) analyses. QRT-PCR analysis was carried out utilizing frozen ground rabbit samples and laser capture microdissection of frozen swine samples. Several statistical methods were used to examine data.

RESULTS: All physes analyzed demonstrated no apparent morphological differences on histological examination. There was no statistical difference in gene expression of aggrecan or type II collagen in rabbit physes (for one-way ANOVA, aggrecan: $p=0.07$, power >0.99; type II collagen: $p=0.28$, power $=0.80$) or swine physes (for one-way ANOVA, aggrecan: $p=0.43$; type II collagen: $p=0.12$).

CONCLUSION: This is the first analysis to examine aggrecan and type II collagen gene expression and physeal structure taken from three different anatomic regions in two different species. No detectable structural or gene expression differences were found in the two species, with sufficient power in one of the species. This result provides credence to the concept of utilizing various physes as control tissue for comparing and analyzing bone pathologies within a single species.

124. Internal Fixation of Unstable Juvenile Osteochondritis Dissecans Lesions of the Knee

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Laura W. Lewallen, M.D.	Rochester, MN
Aaron J. Krych, M.D.	Rochester, MN
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INTRODUCTION: Osteochondritis dissecans (OCD) lesions of the knee are a common cause of knee pain in skeletally immature patients. Unstable lesions require internal fixation; however, the outcomes of these procedures is poorly understood given the variety of surgical techniques.

METHODS: Retrospective review of 20 knees in 19 skeletally immature patients who underwent internal fixation of OCD lesions from 1999 to 2009. The size and location of the lesions, type of internal fixation, Ewing and Voto classification, and the need for further interventions were evaluated. Validated Tegner and Lysholm scoring systems were used to evaluate patients at follow-up. Healing of lesions was assessed by the treating surgeon.

RESULTS: Average patient age was 14.5 with a 7:3 male to female predominance with initial follow-up of 2.5 years. There were five Grade 2 (25%), nine Grade 3 (45%), and six Grade 4 (30%) lesions. Lateral condylar lesions were seen in 11 of 20 patients. Osseous integration was evident in 15/20 (75%) knees, with the five unhealed lesions located on the lateral condyle. Average Tegner activity scores improved from 3.3 preoperatively to 5.6 postoperatively at last follow-up with Lysholm scores of 88 at last follow-up. Further operative intervention was required in 11/20 knees with 50% requiring removal of hardware and three undergoing osteochondral allograft transplantation.

DISCUSSION: Internal fixation techniques for unstable OCD lesions must provide stability and longevity while minimizing iatrogenic joint damage or physeal injury. In our series, outcomes of surgical intervention resulted in osseous integration of 75% and improved outcome scores and return to activity at 2.5 years after surgical intervention. However, 55% of patients with unstable OCD lesions did require multiple operations. Surgical treatment with internal fixation for OCD lesions in skeletally immature patients results in improved functional outcomes.

125. Nonunion After Triple Arthrodesis in Children – Does It Really Matter?

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INTRODUCTION: Triple arthrodesis is a commonly performed salvage procedure to correct hindfoot deformity resulting from a myriad of diagnoses. The surgery is performed in both children and adults. Nonunion is considered an undesirable radiographic outcome; however, the clinical ramifications of radiographic nonunion are not as well-defined, especially in children. The purpose of this study is to determine the incidence of partial or complete radiographic non-union after triple arthrodesis in children and characterize the clinical consequences.

METHODS: An IRB approved retrospective review of triple arthrodesis surgeries in patients less than 16 years of age performed by a single surgeon from 1971 to 2006 identified 159 cases meeting inclusion criteria. Cases were included if there was radiographic evidence of union or if radiographic follow-up was greater than one year, a time deemed sufficient for union to occur. All charts were reviewed for the following outcomes: pain, return to activity, and subsequent hindfoot surgeries, including surgery for consequences of nonunion or clinical symptoms. Descriptive statistics were used to analyze factors that may lead to nonunion.

RESULTS: Of the 159 cases included in the study, only 14 cases (9%) did not achieve complete radiographic union. The complete fusion and nonunion groups had similar outcomes. All patients returned to their previous activities and approximately 85% had no or only occasional pain with prolonged activities. Only one patient required surgery for sequelae of symptoms arising from a pseudoarthrosis related to the triple arthrodesis. The groups were similar in terms of age at surgery, pin and cast removal time, and gender; however, they differed slightly in the time at which weightbearing was allowed, whether they had previous surgeries, and the underlying diagnosis.

CONCLUSION: This is one of the largest case series of pediatric triple arthrodesis surgery presented in the literature. This study demonstrated that good clinical outcomes (return to previous activity levels, no pain, and only one revision surgery) can be achieved despite non-union after triple arthrodesis surgery in children.

126. Poor Applicability of Radiographic Signs for Femoroacetabular Impingement in Pediatric Populations

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Several radiographic measures have been established to help recognize and diagnose femoroacetabular impingement (FAI) in adults. However, a paucity of data exists regarding the application of these measures in pediatric populations. The goal of this study is to investigate the use of common radiographic signs for pincer-type FAI in skeletally immature patients. Plain anteroposterior (AP) radiographs of the pelvis from 52 consecutive pediatric patients were retrospectively reviewed. Images were analyzed for evidence of a lateral center edge angle (LCEA) >39º, an acetabular index (AI) ≤ 0, and cross-over (CO) sign. Demographics and clinical data regarding hip pain and/or range of motion at the time of the radiograph were also gathered. Statistical analysis utilized two-sided z-test for proportions with alpha=0.05. The study population included 33 males and 19 females. A total of 98 hips were analyzed (6 hips were excluded due to grossly abnormal/altered hip anatomy). Mean patient age was 13.56 years (range 8.12-17.23). Overall prevalence of a radiological sign of pincer-type FAI was 81% (79/98). CO sign was present in 76% (74/98), LCEA sign in 11% (11/98), and AI sign in 5% (5/98). Prevalence of CO sign was significantly lower in patients >12 years old (66%) than those ≤ 12 years old (90%, p=0.01). Prevalence of LCEA sign was significantly higher in patients >12 years old (17%) than those ≤ 12 years old (3%, p=0.03). At the time of the radiograph, pain and/or decreased range of motion was reported in 21% (18/84) of hips. In conclusion, 81% of pediatric hips demonstrated radiographic evidence of pincer-type FAI. This high overall percentage was inconsistent with the clinical evidence of FAI in the study group, suggesting poor applicability of adult radiographic measures in the pediatric population. Much of the inaccuracy is likely due to CO sign, which is highly sensitive to patient age. The acetabulum undergoes rapid radiographic changes during adolescence, with the cartilaginous precursor for the anterior acetabular wall typically beginning and completing ossification prior to the posterior wall. This temporal relationship may be resulting in falsely positive cross-over signs.

127. Pediatric Supracondylar Humerus Fractures: Trends in Pin Placement

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BACKGROUND: Pediatric supracondylar humerus fractures are the most common elbow fracture in children. Occasionally, a medial pin is used to create a crossed fixation pattern, which is biomechanically superior to purely lateral pinning. However, iatrogenic ulnar nerve injuries of up to 10% have been reported with medial pinning. Objective of this study was to analyze trends in the operative management of pediatric supracondylar humerus fractures at a Level I academic trauma center.

METHODS: A retrospective review was performed on all children sustaining a Gartland type II or III supracondylar humerus fractures treated by closed reduction and percutaneous pinning in 2006-2007 and 2011 at a Level I academic trauma center by two fellowship-trained orthopedic traumatologists (JTR, LMT). Pin placement patterns were evaluated and compared based on year performed. Outcomes measured were rates of nonunion, re-operation, and varus malalignment defined by a Baumann's angle >80°.

RESULTS: A total of 33 patients met inclusion criteria. Of 15 patients treated in 2006-2007, 3 (20%) were type II and 12 (80%) were type III. In 2011, 11 (61%) were type II and 7 (39%) were type III. Of type II fractures treated in 2006-2007, 2 (67%) had lateral only pinning and 1 (33%) had cross pinning. Of type II fractures repaired in 2011, 10 (91%) had lateral only pinning and 1 (9%) had cross pinning. Of type III fractures repaired in 2006-2007, 2 (17%) had lateral only pinning and 10 (83%) had cross pinning. Of type III fractures repaired in 2011, 6 (86%) had lateral only pinning and 1 (14%) had cross pinning. Comparison of pinning pattern in type II fractures between 2006-2007 and 2011 did not indicate statistical significance ($p=0.396$). Comparison of pinning pattern in type III fractures during the same time period did show that there was a statistically significant decrease ($p=0.013$) in the number of cross pin fixation. There were no nonunions, re-operations, or varus malalignment in any patient on final follow-up.

CONCLUSION: This study shows that there has been a significant decrease in cross pin fixation for pediatric type III supracondylar humerus fractures with equivalent clinical outcomes at a Level I academic trauma center.

128. Late Effects of Clubfoot Deformity in Adolescent and Young Adult Patients Treated with Surgical Intervention

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BACKGROUND: Children with clubfoot deformity often have residual foot deformity, pain, and limited function in adolescence and young adulthood, especially following extensive soft tissue release procedures. These patients represent a heterogeneous group that often requires an individualized management strategy. There is a paucity of literature to help guide the treatment of these patients. Our objective was to review the surgical treatments and outcomes of patients presenting with late effects of clubfoot deformity at our institution, and to identify common patterns in pathology and management within this group.

RESULTS: Forty-five patients were identified that fit our inclusion criteria, with an average age of 13 years. All patients had been treated at a young age with serial casting, and most had at least one prior surgery on the affected foot. Pain with or without deformity was the most common presenting complaint. Average post-surgical follow-up was 13 months. Most patients had improvement of their deformity on physical examination, as well as an improvement in their symptoms. Good or excellent outcomes were assigned to 80% of the patients based on the final follow-up note. Although each case was unique, we found several common patterns with regard to presenting complaints, deformity, and types of surgeries performed. These included clubfoot undercorrection (43%), clubfoot overcorrection (25%), anterior impingement (15%), dorsal bunion (12%), and lateral impingement (5%). Surgeries in the undercorrection group were primarily cavus foot reconstructions or fusion. Surgeries in the overcorrection group were primarily flatfoot reconstructions. Anterior impingement patients typically underwent exostectomy with or without tibial osteotomy, while lateral impingement patients typically had exostectomy with or without calcaneal osteotomy. Surgery for dorsal bunion deformities were corrected using a new double bone block midfoot fusion technique with other forefoot bone and soft tissue procedures and tendon transfers as needed.

129. Evaluation of In-Toeing at a Tertiary Pediatric Orthopedic Specialty Center

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INTRODUCTION: Intrauterine positioning produces a typical lower extremity rotational profile at birth of femoral anteversion and internal tibial torsion. Usually, spontaneous correction occurs after ambulation and childhood growth. This dynamic change in the lower extremity profile results in a wide, age-dependent, range of physiologic normal. Occasionally, slight deviations persist and in-toeing becomes concerning. Most commonly this is due to femoral anteversion, internal tibial torsion, and/or metatarsus adductus. In-toeing is one of the most common parental concerns urging a pediatric orthopedic evaluation. Rarely is toeing a pathologic problem or a cause of functional limitation, and operative treatment is almost never required. The goal of this study is to evaluate the usefulness of tertiary orthopedic referral for the three most common diagnoses leading to pediatric in-toeing: (1) femoral anteversion, (2) internal tibial torsion, and (3) metatarsus adductus.

METHODS: A retrospective chart review identified 1,085 patients from 2007 to 2011 with CPT codes 755.63 (FA), 736.89 (ITT), and 754.53 (MA). Coding data was analyzed for diagnosis, treatment, follow-up, and cost determination.

RESULTS: Over a 5-year interval, patients evaluated for the presenting complaint of in-toeing comprised 7.6% (1,085/14,180) of new patients at a tertiary pediatric orthopedic center with at least one of the following diagnoses femoral anteversion (693, 63.8%), internal tibial torsion (453, 41.7%), or metatarsus adductus (125, 11.5%). Only 18.8% (204) were recommended to follow-up with an average total cost to the patient of $943. The average total cost for patients not recommended to follow-up (881) was $268. Only 26 (2.39%) patients had a corrective osteotomy for persistent, functionally limiting in-toeing.

CONCLUSION: In an era of cost-consciousness, the necessity of tertiary orthopedic referral for in-toeing appears questionable. The dynamic change in the lower extremity profile results in a wide, age-dependent, range of physiologic normal that can be appropriately managed and counseled at the primary care level.

130. Single Event Multilevel Surgery in the Spastic Cerebral Palsy Upper Extremity. A Review of the Expanded Green Transfer

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INTRODUCTION: Cerebral palsy is characterized by static, upper motor neuron weakness most often as a result of a central nervous system injury in the perinatal period. In the spastic form, the upper extremity is most often positioned with shoulder adduction and internal rotation, elbow flexion, forearm pronation, wrist flexion and ulnar deviation, and thumb adduction. In 1942, Green described a procedure involving transfer of the flexor carpi ulnaris (FCU) to the extensor carpi radialis brevis (ECRB) or extensor carpi radialis longus (ECRL) to correct wrist palmar flexion and ulnar deviation. This procedure has now become standard practice to correct for this abnormal positioning. Green also proposed strict preoperative criteria to be met by the patient to predict surgical success.

PURPOSE: The purpose of this study is to determine if a single event multi-level surgery including the Green Transfer provides benefit to the patient when not adhering to Green's criteria to operate.

METHODS: In this retrospective study, patient charts, occupational therapy evaluations, and intraoperative reports for 46 patients who underwent the Green Transfer at our institution from 1997-2011 were reviewed. A single surgeon was the source of all patient data. A sub group of ten patients had pre- and postoperative occupational therapist evaluations. Mean age at surgery was 10.4 (range 6 to 15). No patients had previous surgery of the upper extremity. Nine of the patients were hemiplegic with one quadriplegic. Functional status was determined using the Green and Banks rating scale as modified by Samilson and Morris as well as cosmesis, functional skills, and environmental usage. A novel set of criteria assessed functional variety, frequency of use, and efficiency of care.

RESULTS: There were a total of 111 procedures in addition to the Green Transfer. Three patients needed revision surgery. Six patients needed additional surgery. Using the Green and Banks rating scale, preoperatively there were 4 poor, 4 fair, 2 good, and no excellent. Post-operatively, there were 1 poor, 6 fair, 3 good, and no excellent. Cosmesis improved an average of 2.4 points with all patients showing improvement. Functional skills improved an average of 0.8 points with 6 showing some improvement, 3 showing no improvement. Environmental usage improved an average of 0.1. One patient showed improvement, 8 showed none. Functional variety improved an average of 0.3 points, frequency of use improved an average of 0.5 points, and efficiency of care improved an average of 0.3 points.

DISCUSSION AND CONCLUSION: Cerebral palsy is a debilitating long-term disease that causes severe impairment in daily functioning. The Green Transfer, as part of a multi-level surgical approach in the spastic upper extremity, provides an opportunity to improve position, cosmesis, and functional use of the involved limb. Studies have examined selection criteria for surgery to determine if co-variables influence the outcomes of the procedures. This study found improvement in patients who did not meet the Green criteria. The best results were from patients that had some active pincer grasp with the wrist in extension prior to surgery. In absence of fulfillment of Green's criteria for surgery, patient's quality of life can still improve with improved cosmesis and functional skills. More liberal patient selection criteria are warranted.

131. Functional Outcomes After Operative Management of Pediatric Tibial Plateau Fractures

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BACKGROUND: Pediatric tibial plateau fractures are rare injuries. Improved adult tibial plateau fracture management has been made possible due to the introduction of external fixators and locked fixation devices. This has not been reported in pediatric literature.

METHODS: Between 2005 and 2011, our institution has surgically treated 13 pediatric tibial plateau fracture patients. Mean age at the time of injury/surgery was 14.0 years (range 9-18 years). There were 11 boys and 2 girls. There were 8 S-H IV fractures and 5 S-H III fractures. Preoperatively, radiographs and CT scans were obtained. A temporary spanning external fixation was used for soft-tissue resuscitation prior to definitive fracture reconstruction. Double plating was used in fractures with a displaced coronal split component of the posterior aspect of the medial tibial plateau. Clinical and radiographic data, including fracture pattern, changes in alignment, local and systemic complications, hardware failure, and fracture union were analyzed. Knee osteoarthritis outcomes scores (KOOS) were collected at the last follow-up.

RESULTS: Mean follow-up for the 13 patients was 13.32 months (range 6-48). Two patients received fasciotomy for compartment syndrome and both had skin grafting for final wound closure. Six lateral meniscus lacerations were found in surgery and repaired. There were two deep MCL ruptures and one ACL detachment that were also repaired. Locked proximal tibial plate was used in 8 out of 13 cases. All fractures progressed to union at a mean of 2.5 (range, 2-3.5) months. KOOS subscales averages were: pain (89), symptoms (85), ADL (90), sport/rec (75), and QOL (78).

CONCLUSIONS: Spanning external fixator and locked fixation device provided stable fixation of pediatric tibial plateau fractures with a low complication rate. This is the first study showing successful surgical management of pediatric tibial plateau fracture management with locked device fixation and good outcome. It also highlights the high incidence of meniscus and collateral ligament injury in this special population.

132. Association of Pediatric Pelvic Ring Injuries with Injury Severity Score and Transfusion Needs

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INTRODUCTION: The purpose of this study is to determine whether pelvic fracture pattern is associated with transfusion requirements or concomitant injuries in pediatric and adolescent patients.

METHODS: This was a single institution, retrospective review from 1970 to 2000. Pelvic ring injuries were classified using the Orthopedic Trauma Association (OTA) system. Associated injuries were recorded, and injury severity score (ISS) was assigned retrospectively.

RESULTS: Ninety patients were included in this study. There was a nearly equal gender distribution, and an average age of 10.9 years. The most common mechanism of injury was motor vehicle accident (41.1%).

There were 27 A-type (30.0%), 51 B-type (56.7%), and 12 C-type (13.3%) injuries. The mean ISS scores by fracture sub-classification were: 8.1 for 61 A, 12.7 for 61 B, and 23.6 for 61 C ($p<0.0001$).

Blood transfusions were administered in 23.9% of patients. 14.8% of A-type, 18.4% of the B-type, and 66.7% of the C-type injuries required transfusion ($p=0.0009$). There was no significant association with the number of units transfused ($p=0.9614$).

DISCUSSION/CONCLUSION: Decreased pelvic ring fracture stability was associated with an increased need for blood transfusion, though not the number of units. In addition, pelvic ring fracture stability may be a marker of associated injuries.

133. A Novel Technique for Pediatric Femoral Locked Submuscular Plate Removal: The "Push-Pull" Technique

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INTRODUCTION: To reduce soft tissue damage, bleeding, scarring, and pain, a minimally invasive procedure to remove submuscular femoral plates utilizing the pre-existing incisions while controlling the implant is efficient and beneficial. The purpose of this study was to describe the surgical technique and to illustrate the performance of the procedure and its limitations.

METHODS: Twenty-six patients were identified that underwent submuscular plating for femoral fractures between 2005 and 2010. Thereof, 21 (81%) implants were removed using the described technique.

RESULTS: Average age was 8 years. The reason for plate removal was surgeon's recommendation (18), beginning bone overgrowth (1), and irritation (2). Median plate length was 14 holes. Plates were 3.5 mm locking compression (20) and 3.5 mm compression plates (1). Time from plate insertion to removal was 8.0 months (range 4.0 to 26.6). Because of implant removal difficulties, one patient (4.8%) required a change to an open approach. The complication was caused by a cold welded screw head. An anticipated broken screw was retrieved completely through the incisions. All implants were removed completely. No postoperative complications regarding hematoma formation, wound healing problems, infections, or nerve injuries were recorded.

CONCLUSION: Minimally invasive removal of long bone plating in pediatric patients can be successfully performed utilizing the described "push-pull" technique. Indications should exclude anatomic sites endangering neurovascular structures and local difficulties including bone overgrowth and broken or stripped screws.

MAOA BREAKOUT SESSION #10
SPINE
April 19, 2013

135. Outpatient Surgery Reduces Short-Term Complications in Lumbar Discectomy

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BACKGROUND: Lower costs, greater patient satisfaction, and equivalent safety have been reported with outpatient surgery for lumbar discectomy. The purpose of this study was to compare complication rates and safety in patients undergoing inpatient versus outpatient single level lumbar discectomy.

METHODS: Patients undergoing lumbar discectomy between 2005 and 2010 were selected from the ACS NSQIP database. Patient selection was based on a single primary CPT code. In order to ensure comparable inpatient and outpatient cohorts, patients with multi-level procedures were excluded. Thirty-day postoperative complications and preoperative patient characteristics were identified and compared. Propensity score matching and multivariate logistic regression analysis were used to adjust for selection bias and identify predictors of 30-day morbidity.

RESULTS: Of the 4,310 lumbar discectomy cases, 2,658 (61.7%) underwent an inpatient hospital stay following surgery, while 1,652 (38.3%) patients had outpatient surgery. Unadjusted overall complication rates (6.5% vs. 3.5%, $p<0.0001$) were higher in those undergoing inpatient surgery. After propensity score matching, overall complication rate was still higher with the inpatient cohort (5.4% vs. 3.5%, $p=0.0068$). Adjusted comparison using multivariate logistic regression, also demonstrated a significantly higher rate of complication for inpatients (Odds Ratio 1.521; 95% CI 1.048-2.206). Age, diabetes, presence of preoperative wound infection, blood transfusion, operative time, and an inpatient hospital stay were all independent risk factors of short-term complication after lumbar discectomy.

CONCLUSIONS: After adjusting for confounders using propensity score matching and multivariate logistic regression analysis, patients undergoing outpatient lumbar discectomy had lower overall complication rates than those treated as inpatients. Surgeons should consider outpatient surgery for lumbar discectomy in appropriate candidates.

136. Analysis of Cervical Angiograms in Cervical Spine Trauma Patients. Does it Make a Difference?

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INTRODUCTION: Blunt vertebral artery injury (BVAI) is an example of a previously under-diagnosed injury. The ease of CT angiogram (CTA) has simplified evaluation for these injuries in the trauma patient. The most significant question to address is the value of routine screening and its impact on patient care. The purpose of this study is to assess the effect of routine CTA for the diagnosis of BVAI in the poly-trauma patient.

MATERIALS AND METHODS: After IRB approval, charts of patients age 18-89, who presented with cervical spine fracture over the six year period from 2006-2011 were reviewed. Data collection included routine demographic data, type of fracture, and neurologic symptoms. Results of CTA/MRA, type of treatment, and complications were also recorded. We specifically assessed complications of the CTA and the resultant treatment of the BVAI.

RESULTS: 108 subjects underwent evaluation with CTA/MRA; 15 were found to have vertebral artery injuries. Four of those with documented vertebral artery injuries did not have contraindications to treatment. No patients were found to have complications from the angiogram, or treatment of a BVAI. Eight subjects who did not have CTA/MRA evaluation had complications that may have been related to VAI. Proportions were used to determine if there was a significant difference in complications between those subjects who had cervical spine fractures and did not receive a CTA and those that were found to have a vertebral artery injury on CTA. The proportion was found to equal 0.81, $p>0.05$. The proportion of subjects with complications who had a positive CTA versus a negative CTA was 0.86, $p>0.05$.

CONCLUSION: Our study suggests that BVAI is rarely associated with symptoms, and that the patient with BVAI is frequently unable to receive treatment. No reduction in complications was seen in those that received screening compared to those that did not undergo CTA/MRA. Our study reinforces the need to establish clear protocols to determine which patients would benefit from evaluation.

137. Osteoporosis Care After Fragility Fracture

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INTRODUCTION: Prompt diagnosis and treatment of osteoporosis in fragility fracture patients is crucial to preventing refracture. Studies have shown, however, that orthopedic surgeons do poorly in diagnosing and treating osteoporosis in this population. Given our awareness of these studies, as well as initiatives such as The Bone and Joint Decade and the AAOS position statement on Enhancing the Care of Patients with Fragility Fractures, we hypothesized that our institution's performance would compare favorably to performance cited in previous studies.

METHODS: We searched our electronic medical records based on ICD-9 codes for patients >50 who sustained fractures of the spine, distal radius, and proximal femur from 1/03 to 7/08. To isolate new fragility fractures in patients not being treated for osteoporosis, we excluded patients whose fractures were pathologic, old, associated with trauma, as well as patients taking an active osteoporosis medication at the time of fracture. Our main outcome measures were DEXA scan, Endocrinology referral, and initiation of an active osteoporosis medication within one year of fracture.

RESULTS: 164 of 315 potential patients met inclusion criteria. Eighteen had a vertebral compression fracture, 134 had a distal radius fracture, and 12 had a hip fracture. Of the 164 patients, 25 (15%) received a DEXA scan, 5 (3%) were referred to Endocrinology, and 12 (7%) started an active osteoporosis medication. In previous studies, the percentage of fragility fracture patients subsequently receiving a DEXA scan ranged from 3% to 39%; referrals to Endocrinology ranged from 25% to 35%; starting an active osteoporosis medication ranged from 10% to 28%.

CONCLUSION: At our institution, the percentage of fragility fracture patients who subsequently received a DEXA scan is similar to percentages cited in other studies. Our percentage is lower for endocrine referrals and starting an active osteoporosis medication. We suggest that if institutions want to improve their diagnosis and treatment of osteoporosis in fragility fracture patients they should consider, as we are, instituting a specific fragility fracture treatment pathway.

138. Evaluation of the Utility of the Wells Score for Predicting Pulmonary Embolus in Patients Admitted to the Spine Surgery Service

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INTRODUCTION: The decision to perform computed tomography pulmonary angiography (CTPA) to diagnose pulmonary emboli (PE) in spine surgery patients is challenging. Although accurate diagnosis is important, CT scans expose patients to radiation, are costly, and false positive results may lead to unnecessary anticoagulation. Scoring systems such as the Wells score have been established to assign risk categories for patients suspected of PE to assist in determining need for CTPA. The utility of the Wells Score for predicting PE in spine surgery patients has not been described.

METHODS: All patients admitted to the spine service who underwent CTPA from 2001-2011 were identified. CTPAs were determined to be “positive” or “negative” for PE based on radiologist interpretation. The Wells score was calculated for each patient by a blinded reviewer and risk categories utilizing the “traditional” and “alternative” Wells score were assigned. Billing data from each patient was reviewed. Reason for examination and Wells score risk category were compared for patients with and without PE.

RESULTS: In total, 4,179 patients were admitted to the spine service; 66 underwent CTPA for suspected PE. Nineteen of the 66 (28.8%) were diagnosed with acute PE (overall PE rate 0.45%). Patients with cervical diagnoses or combined cervical and thoracic injuries were more likely to have a positive CTPA examination compared to patients with isolated thoracolumbar diagnoses (62.5% vs. 24.1%;p=0.025). The mean Wells score for patients diagnosed with PE was 5.3; the mean Wells score for patients without PE was 4.9 (p=0.793). Neither the “traditional” or “alternative” interpretation of the Wells score was predictive of PE (p=0.394, p=0.178 respectively). Mean cost for CTPA was $2,158.

CONCLUSION: This study found no significant correlation between the Wells score and results of CTPA in spine surgery patients. Fewer than 1/3 of CTPA scans were positive for PE. Conservative ordering of CTPA exams is encouraged.

139. Comparison of Cranial Facet Joint Violation Rates Between Open and Percutaneous Pedicle Screw Placement Using 3-D CT Computer Navigation

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INTRODUCTION: Facet joint violation reportedly results in a higher rate of adjacent segment degeneration. Reported facet joint violation rates range from 7% to 100%. Image-guided techniques have enhanced pedicle screw placement accuracy. The aims of this study are to determine if 3-dimensional (3D) CT image-guided pedicle screw placement reduces cranial facet joint violation and to compare the rates of facet joint violation between open and percutaneous techniques.

METHODS: We reviewed 188 cases of 3D image-guided lumbar pedicle screw instrumentation from November 2006 to December 2011. Surgeries were conducted at one institution by three fellowship-trained spine surgeons. The cranial screws of each construct were graded according to the Seo classification (0=no impingement; 1=screw head in contact/suspected to be in contact with facet joint; 2=screw clearly invaded the facet joint) on intraoperative axial CT images. Grading was performed by three reviewers. If there was a difference in evaluation, consensus was reached to arrive at a single grade for each screw. Chi-square was used to determine significance between the open and percutaneous group ($a=0.05$).

RESULTS: A total of 370 screws (245 open, 125 percutaneous) were graded. Overall facet joint violation rate was 18.9% (Grade 1=16.2%, Grade 2=2.7%). Open technique (Grade 1=22.4%, Grade 2=4.6%) had a significantly higher violation rate than percutaneous technique (Grade 1=4%, Grade 2=0%) ($p<0.001$). There is a trend of an increasing likelihood of facet joint violation as one moves caudally from L1 to L5 reflecting the difficulty of avoiding the facet joints at the more caudal levels due to facet orientation and presence of the iliac crests.

CONCLUSION: The use of intraoperative CT image-guidance in lumbar pedicle screw placement resulted in a facet joint violation rate at the lower end of the reported range in literature. The percutaneous technique has a significantly lower cranial facet violation rate than the open technique. Screws inserted percutaneously have more lateral entry points which tend to avoid the facet joint. None of the violations in the percutaneously inserted screws showed complete impingement.

140. No Neurological Deficits Using a Bilateral Transforaminal Lumbar Interbody Fusion Approach and a Novel Low Profile, Expandable Interbody Device

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SUMMARY: Circumferential 360º lumbar fusion may be achievable by a single posterior surgical approach, using the bilateral transforaminal lumbar interbody fusion (TLIF) approach to obtain interbody and posterolateral fusion in combination with a low profile, expandable, and radiolucent lordotic interbody device.

OBJECTIVE: To determine if there was any neurological deterioration associated with the patients undergoing bilateral TLIF approach and the low profile, expandable interbody fusion device to achieve interbody fusion.

MATERIALS AND METHODS: Retrospective case control study in a single institution by a single surgeon over an eight-month period from March to November 2011 involving all the patients who underwent this procedure. Each patient underwent a full neurological assessment, including an ASIA score, both pre- and postoperatively.

RESULTS: Forty-five patients underwent this procedure. Thirty-two (71%) patients were female, and 13 (29%) patients were male. The average age was 64 years (range 40- 86 years). Thirty-eight (84%) patients underwent a single level interbody fusion (range 1-2). The L4/ L5 (43%) level was the most commonly involved, with the L5/S1 (27%) level the next most frequent. Average blood loss was 530 ml/patient (range 200-2000 ml). Inpatient hospital stay was 6 days (range 3-16 days). Mean follow-up was 52 weeks (range 24-70 weeks), and the early clinical and radiological follow-up data demonstrate satisfactory function and early fusion. There were no cases of dural laceration, infection, or neurological deterioration after surgery. No patients required revision surgery for implant subsidence, translation, or removal. One patient required decompression of a more proximal stenosis, after developing new symptoms in the postoperative period.

CONCLUSION: The bilateral TLIF approach and low profile expandable devices were not associated with any neurological deficits and may be an alternative posterior surgical technique to achieve balance and interbody fusion.

141. Salvaging Failed Lateral Mass Screw Fixation in the Subaxial Cervical Spine (C3-C7) with Bone Cement♦

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PURPOSE: To evaluate the feasibility and mechanical performance of placing lateral mass screws back into C3-C7 lateral masses after creating intentional lateral mass "cut-out" defects.

STUDY DESIGN: Biomechanical testing and clinical examination of instrumented human cadaveric cervical vertebrae under applied dorsal pullout loading for the comparison of a new lateral mass salvage procedure versus the standard lateral mass screw.

PATIENT SAMPLE: Cadaveric (n=15) cervical vertebrae.

OUTCOME MEASURES: Pullout load and mode of failure.

METHODS: Three fresh frozen cadaveric cervical spines were used. Fifteen subaxial cervical vertebrae from C3-C7 were instrumented. The right side of the specimens 3.5 x 12 mm lateral mass (LM) screws were placed in a standard fasion and served as a control. The left side lateral masses were intentionally "cut-out" utilizing a 2.5 mm drill so that a screw could not be placed. The "cut-out" LMs were then augmented with either Cortoss® or PMMA. After the cement hardened, lateral mass screws were placed at each level. After instrumentation, each vertebra was fixed rigidly to the table of a servo-hydraulic (Instron 8821s) load frame. A screw pullout fixture was attached to the head of the LM screw. Dorsal pullout force was applied to screws at a constant rate of 0.2 mm/s until failure. Maximum and mean force to failure between native and salvage screws were compared using a student's t-test with $p<0.05$.

RESULTS: Average pullout force of the standard LM screws was not statistically different from the salvage LM screws (117N and 99N respectively $p=0.34$). Standard LM screws did have a higher pullout force when compared to screws salvaged with Cortoss (109N vs. 79N, $p<0.05$). Salvage screws utilizing PMMA actually showed greater pullout force when compared to standard LM screws (151N vs. 66N, $p<0.05$).

CONCLUSIONS**:** Our testing demonstrates that salvage of "cut-out" lateral mass screws with cement augmentation can result in pullout strength comparable to a well placed primary lateral mass screw. Cortoss and PMMA both appear to be viable options for salvaging lateral masses screws after cut-out. PMMA applied in a very liquid state yields the highest pullout strength and in this study, lateral mass screws salvaged with this PMMA demonstrated greater pullout than native lateral mass screws. This salvage technique for a cut-out LM screw is novel and potentially very beneficial to surgeons.

142. Experimental Lumbar Spine Fusion with Beta Tricalcium Phosphate Ceramic Composite Graft and Bone Marrow Aspirate

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BACKGROUND: Synthetic bone grafts with osteoconductive and osteoinductive properties are under investigation to identify viable alternative sources to autograft in spinal surgery.

OBJECTIVE: To evaluate the fusion rates of three combinations of synthetic tricalcium phosphate bone graft substitute in comparison to autologous iliac crest harvested bone graft (ABG) in a rabbit fusion model.

MATERIALS AND METHODS: Sixty-six (66) male New Zealand White (NZW) rabbits, with a mean weight 4.2 kg (range 3.2-5.2 kg), were divided into four groups, and underwent uninstrumented, bilateral posterolateral spine arthrodesis with one of the following grafts: (1) ABG (n=16), (2) ABG plus ceramic polymer composite strip (n=16), (3) whole bone marrow with ceramic polymer composite granules (n=16), and (4) whole bone marrow with ceramic polymer composite strip (n=16). Fusion at 12 weeks was assessed by manual palpation, fine detail radiography (Faxitron), microcomputed tomography (CT) imaging, and nondestructive biomedical testing and histology.

RESULTS: Significant differences in manual palpation were found by three observers between the groups, with the ceramic polymer composite strip and bone marrow aspirate group demonstrating the highest fusion of 86.7%, while the ABG group had a 68.8% fusion success. On both radiographs and CT scans, the fusion mass appeared solid (Faxitron: 100%, CT: 100%) in the ceramic polymer composite strip and bone marrow aspirate group than the ABG only group (Faxitron: 86%, CT: 66.6%). Histology confirmed the integrity (100%) of the fusion mass in the ceramic polymer composite strip and bone marrow aspirate group, in comparison to the ABG group and the ABG plus ceramic polymer composite strips (67% and 75%, respectively).

CONCLUSION: Our results suggest that synthetic tricalcium phosphate bone graft strips in bone marrow aspirate may now be considered an ABG in spinal arthrodesis.

143. Lumbar Spinal Stenosis: Evaluation of Information on the Internet

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INTRODUCTION: A substantial percentage of Internet users search for medical information on the Internet. Because no standards exist regarding the publication of medical literature on the Internet, the relevant web sites vary dramatically in terms of content and quality. The objective of this study was to evaluate the type and quality of online health information available to patients on the topic of lumbar spinal stenosis.

METHODS: The search term “lumbar spinal stenosis” was entered into the most commonly used search engine for health-related searches (www.google.com). The first 50 links displayed were evaluated in terms of content, authorship, and secondary commercial gain. An information quality score (IQS) of 0 to 25 points was generated for each site; a score greater than 20 was indicative of "high-quality" content.

RESULTS: The overall mean IQS was 18.4. This search identified 22 websites (44%) which scored >20 on the information quality score, while 4 websites (8%) scored <10. Highest mean scores were noted for commercial corporate (21.9) and hospital-based sites (20.3). Overall, 58% of sites sought secondary commercial gain. Sites seeking commercial gain did not vary significantly in IQS compared to sites not seeking commercial gain (18.0 vs. 18.7, respectively; $p=0.718$). The rank order in which the site appeared in the search exhibited a weak negative correlation to information quality score ($r = -0.23$).

CONCLUSION: The quality of Internet information on lumbar spinal stenosis is variable. Less than 50% of relevant web sites were determined to be of high quality. More than one-half of the websites sought secondary commercial gain. The rank-list of high quality sites generated from our informational quality score may be useful to patients seeking information on the Internet pertaining to lumbar spinal stenosis.

144. New Formulation of Demineralized Bone Matrix Putty Performs Substantially Equivalent to Iliac Bone Graft in Rabbit Posterolateral Lumbar Spine Arthrodesis

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BACKGROUND CONTEXT: Alternative grafts to autogenous iliac crest bone graft (ABG) that avoid morbidity while maintaining ABG's osteoconductivity, osteoinductivity, and osteogenic potential are under investigation.

PURPOSE: To compare the efficacy of a new formulation of DBM putty to that of ABG.

MATERIALS AND METHODS: Twenty-four (24) male New Zealand White (NZW) rabbits, underwent bilateral posterolateral spine arthrodesis of the L5- L6 intertransverse processes, using either ABG (control group, n=12) or DBM (DBM made from rabbit bone) putty (test group, n=12). Fusion success was evaluated by manual palpation, high-resolution x-rays of the excised spine by the Lenke scale, micro-computed tomography (micro-CT) and four-point non-destructive biomechanical bending. Finally, undecalcified histologic analysis was performed.

RESULTS: Manual palpation by three observers to assess fusion success in the explanted lumbar spines showed successful fusion in 81.8% (9/11) of the test group and 72.7% (8/11) of the control group which were equivalent (p=0.99). Fusion was assessed as solid (Lenke A score) in 10 of the DBM and 9 of the ABG specimens (p>0.59). Biomechanical testing showed no significant difference in stiffness between the control and test groups on flexion, extension, left lateral and right lateral bend, with p values accounting for 0.79, 0.42, 0.75, and 0.52, respectively. Bone volume/total volume was greater than 85% in DBM treated fusion masses. Histological evaluation revealed mature fusions with little remains of graft material in the DBM-treated group. The ABG-treated group was less mature with greater areas of graft material still present.

CONCLUSION: The DBM putty proved equivalent to ABG in the posterolateral intertransverse rabbit model and deserves consideration as an alternative to iliac crest autograft in spinal arthrodesis, avoiding donor site morbidities associated with bone graft harvesting.

145. Does Vancomycin Powder Reduce Deep Infections in Posterior Spinal Surgery: A Comparative Study

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INTRODUCTION: No study has investigated the efficacy of vancomycin powder to reduce post-operative infection in a consecutive series of all indications for posterior spinal surgery through a defined time period.

METHODS: A consecutive series of all patients who underwent posterior cervical spine surgery by two surgeons between July 2010 and December 2011 were reviewed. There was no difference in the preoperative antibiotic regimen of both surgeons. One surgeon applied 1 g vancomycin powder directly into the surgical bed prior to closure of the wound in all of his patients while the other surgeon did not. These two groups were compared with respect to: gender, age, diabetes, smoking status, BMI, operative time, blood loss, and occurrence of postoperative infection. Patients with infections were categorized to whether or not their infection required operative debridement as part of the overall medical treatment versus medical treatment alone.

RESULTS: Group A (Control) consisted of 154 patients and Group B (Adjunctive Vancomycin Powder) consisted of 121 patients whose mean ages were 58.8 ± 14.75 years and 55.63 ± 15.26 years, respectively. Group A was predominantly female gender (55% female) while Group B (43% female) consisted of more men. The mean BMI (Group A: 29.9; Group B: 28.7) and mean ASA scores (Group A: 2.45; Group B: 2.44) were similar between the groups. Group A had significantly shorter operating time (Group A: 184.6 minutes vs. Group B: 227.0 minutes; [p=0.001]) but greater amount of blood loss (Group A: 267.37 ml vs. Group B: 192.3 ml; [p=0.064]). Both groups had low rates of deep infection requiring operative debridement; however, Group A's rate of infection requiring operative debridement (0.0%) was significantly greater than Group B's rate (3.9%), (p=0.036) with Fisher's exact test.

CONCLUSION: The results of this study demonstrate that adjunctive vancomycin powder applied directly to the surgical bed just prior to closure is highly effective in preventing deep infections requiring operative debridement in all types of posterior spinal surgery.

146. Civilian Gunshot Injuries to the Spine: An Update on Surgical Indications, Long-Term Outcomes, and Complications

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INTRODUCTION: Civilian GSWs to the spine are commonly treated at urban trauma centers, but no major series of these injuries in the civilian population has been described in more than 15 years. We present the second-largest series of civilian spine GSWs in the literature.

METHODS: Patients were retrospectively identified using an ICD9 code search of hospital records from 2003-2011 at a single urban Level I trauma center. We identified 159 consecutive patients with both spine fractures and injury by firearm.

RESULTS: There were 147 male and 12 female patients, with mean age 28 years (range 16-65). Mean follow-up was 13 months, with 35 having >2 year follow-up. Mean hospital LOS was 13 days. The C-spine was involved in 46 cases, the T-spine in 53 cases, the L-spine in 50 cases, and the sacrum in 10 cases. The vertebral body and transverse processes were most-commonly fractured (30% and 31% of cases). Non-spine injuries were also present in 123 patients (77%), and 104 patients (65%) required non-spinal surgery.

Ten patients were treated operatively; indications were epidural abscess (1 patient presented at 21 days and the other at 50 days post-GSW), persistent CSF leak (1 patient), instability (6 patients), and decompression of an incomplete spinal injury (4 patients). Nonoperative stabilization was via c-collar in 42 cases, thoracolumbar brace in 24 cases, and halo vest in 3 cases. Seventy-nine patients were initially ASIA grade E. Twenty patients with initial deficits experienced improvement of at least one ASIA grade (25% of patients with initial deficits); one of these was operatively treated. Four improved patients were initially ASIA A, 4 were ASIA B, 8 were ASIA C, and 4 were ASIA D. Seventy patients (44%) experienced at least one complication. The most-frequent long-term complications were recurrent urinary tract infections (15 patients), decubitus ulcers (11 patients), deep vein thromboses (10 patients), and pneumonia (9 patients).

CONCLUSIONS: Spinal GSWs are accompanied by significant multi-system morbidity, but there is potential for neurologic improvement. In general, nonoperative treatment is indicated; indications for surgical intervention are narrow, but should be considered in patients with incomplete lesions or deteriorating neurologic status.

147. Enhanced Bone to Bone Healing via Pectoralis Major Transfer with Its Bony Insertion to Stabilize Symptomatic Scapular Winging

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PURPOSE: Study the outcome of transfer of the sternal head of the pectoralis major with its bony insertion to the inferior pole of the scapula for symptomatic winging secondary to serratus anterior paralysis.

METHODS: Fifteen patients had serratus anterior paralysis secondary to trauma or prior surgery with documented long thoracic nerve injury by EMG. Indications included pain, scapular winging, and limited active range of motion. All patients underwent transfer of the sternal head of the pectoralis major with its bony insertion to the inferior pole of the scapula. At three months postoperatively, all patients underwent a dynamic ultrasound of the pectoralis and CT scan of the scapula. If bone healing was confirmed, then the patient is allowed to progress quickly to strengthening and unrestricted activities.

RESULTS: At an average follow-up of 19 months, 12 patients had complete and 3 patients had partial resolution of the scapula winging. Shoulder range of motion improved significantly with improvement of active shoulder forward flexion from 98^{o} to 135^{o} ($p<0.01$), and abduction from average 82^{o} preoperatively to 118^{o} postoperatively ($p<0.01$). All 15 patients reported pain levels as moderate or severe preoperatively, while only 2 out of 15 reported moderate or severe pain after surgery ($p<0.01$). The mean shoulder Constant Score improved from 45, with a relative score of 51% preoperatively to 76, with a relative score of 81% postoperatively ($p<0.01$). The shoulder subjective value was 48% preoperatively to 77% postoperatively ($p<0.03$). Finally, the preoperative and postoperative DASH score improved from 53 to 14, respectively ($p<0.01$). CT scans at an average three months postoperatively demonstrated full healing in 13 patients and partial healing in 2. Dynamic ultrasound of the pectoralis major muscle demonstrated normal muscle contraction during active shoulder flexion in 11 patients and weak contraction in 4 patients. Fourteen of 15 report their shoulder as significantly better than preoperatively.

CONCLUSIONS: Transfer of the sternal head of the pectoralis major with its bony insertion to the inferior pole of the scapula does stabilize and restore the function to the scapula in patients with symptomatic winging. The main advantages of this technique are the ability to directly transfer the tendon to the scapula with bone to bone healing potential which allows faster healing of the repair that in turns leads to quicker return to full unrestricted activities.

148. One-Stage Bilateral Total Knee Arthroplasty: Analysis of Safety Outcomes

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The safety of one-stage bilateral total knee arthroplasty (bTKA) has remained a controversial topic. There is conflicting literature to date. The objective of this review was to compare the safety of the two procedures. Eighty consecutive bTKA patients were matched with 80 patients undergoing unilateral TKA (uTKA). Similar techniques and perioperative protocols were used. We analyzed perioperative outcomes and complications. Significant findings included (higher in bTKAs): (1) longer mean length of hospitalization, 4.6 vs. 3.3 days (p=<0.001), (2) greater need for inpatient rehabilitation, 65% vs. 6.3% (p=<0.001), (3) greater transfusion requirement, 31% vs. 11% (p=0.002), (4) higher symptomatic venous thromboembolism (VTE), 11% vs. 1% (p=0.005), and (5) greater systemic complication rate, 17.5% vs. 5% (p=0.01). Comparing patients age >70 with age ≤70 within the bTKA group, significant findings included (higher in age >70): (1) higher symptomatic VTE rate, 31% vs. 6% (p=0.01), (2) greater systemic complication rate, 44% vs. 11% (p=0.005), (3) higher any complication rate, 50% vs. 17% (p=0.009), and (4) greater transfusion requirement, 56% vs. 25% (p=0.019). One-stage bTKAs were associated with higher perioperative complications when compared to uTKAs in our patient population. This difference was especially profound for one-stage bTKA patients age >70. Age >70 may be a relative contra-indication for a one-stage bilateral procedure.

149. Wear Rates of Highly Cross-Linked Polyethylene in a Reverse Total Shoulder Arthroplasty Wear Simulation

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BACKGROUND: Reverse total shoulder arthroplasty (rTSA) continues to utilize conventional ultra-high molecular weight polyethylene (PE) as a bearing surface. Highly cross-linked PE has demonstrated lower wear rates in total hip arthroplasty; however, no studies have characterized the use of highly cross-linked PE in the setting of rTSA. It is hypothesized that highly cross-linked PE will reduce total wear in an rTSA in vitro simulation.

METHODS: Utilizing a wear simulation protocol previously developed at our institution, six conventional PE liners and six highly cross-linked PE liners were prepared for testing. PE liners were mounted to a MTS 12-station simulator for cycles of simulated abduction-adduction (abd-add) and flexion-extension (flex-ext) loading profiles. Every 250,000 cycles loading profiles were alternated and fluid was collected for further analysis and characterization of PE particles.

RESULTS: At this time, 4,000,000 cycles out of 5,000,000 planned cycles have been completed. The average volumetric wear rate for non-cross-linked PE was 82.8 ± 21.3 mm^3/million cycles (MC); significantly higher compared to an average volumetric wear rate of 36.2 ± 10.8 mm^3/MC ($P<0.001$) for highly cross-linked PE. For non-cross-linked PE, the flex-ext profile (101.3 ± 4.6 mm^3/MC) exhibited a statistically higher wear rate compared to the abd-add profile (64.4 ± 13.2 mm^3/MC) ($P<0.001$). Similarly, within the highly cross-linked PE group, there was a significant difference between flex-ext (44.4 ± 4.8 mm^3/million cycles) and abd-add profiles (27.9 ± 8.6 mm^3/MC) ($P=0.002$). A statistically significant difference in total volume loss between non-cross-linked and highly cross-linked PE was also noted (331.3 ± 37.5 mm^3 and 145.4 ± 9.6 mm^3, respectively) ($P<0.001$).

DISCUSSION AND CONCLUSION: A significant reduction of PE wear with the use of highly cross-linked PE in our model was observed after 4,000,000 of 5,000,000 planned cycles. Decreased wear may help increase device longevity by mitigating glenoid bone loss due to particle-induced osteolysis. In conclusion, cross-linking appears to convey increased wear properties of PE liners in a rTSA wear simulation.

150. Trends in Orthopedics: An Analysis of Medicare Claims, 2000-2010

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BACKGROUND: There are few studies investigating the contribution of orthopedics to overall trends in healthcare spending.

METHODS: The Medicare Part B claims database for years 2000-2010 was queried. The database is organized by Current Procedural Terminology code; those surgical procedures designated as “musculoskeletal” were identified, and those outside the purview of orthopedics were excluded from consideration. For each procedure, annual volume and reimbursement were recorded. The procedures were grouped into 12 anatomical or functional groups for multiyear analysis. Utilization rate per 1,000 Medicare beneficiaries and compound annual growth rate (CAGR) of payments were calculated. Trends were then compared against national inflation and healthcare spending data.

RESULTS: Medicare payments for orthopedic procedures increased 59.5% over the last decade, from $1.6 billion in 2000 to $2.6 billion in 2010. The number of procedures increased by a similar proportion, from 8.2 million to 13.5 million (64.5%), so that average reimbursement per procedure declined slightly. Considerable variation was found when the procedures were broken down by our analysis, with payments increasing the most in spine (CAGR 12.5%) and endoscopy (CAGR 9.3%), and the least in pelvis and hip (CAGR 0.7%) and hand and fingers (CAGR 1.1%) groups. Over the same period, total healthcare spending in the United States increased at a CAGR of 6.5%, while total Medicare payments rose at a CAGR of 8.9%.

CONCLUSIONS: The growth in orthopedic payments revealed by this study can be annualized at a CAGR of 4.8%; this tracks well below overall healthcare spending and total Medicare payment growth for the period. The modest growth in orthopedic payments appears to contradict the idea that orthopedics is a major culprit in rising health costs. Only spinal and endoscopic procedures stand out as having experienced exceptional growth, but there is agreement that these areas have seen significant productive innovation over the past decade.

151. Risk Factors for Recurrent Instability Following Acute Patellofemoral Dislocation

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INTRODUCTION: The purpose of this study was to describe the demographics of patients with a first time patellofemoral dislocation, and identify risk factors for recurrent instability.

METHODS: This was a single institution, IRB approved, retrospective review of >2,000 patients with a patellar dislocation between 1998 and 2010. Inclusion criteria consisted of: (1) no prior history of patellofemoral subluxation or dislocation of the affected knee, (2) x-rays within four weeks of the initial instability episode, and (3) a dislocated patella requiring reduction, or history/findings suggestive of acute patellar dislocation (effusion/hemarthrosis, medial tenderness, and apprehension).

The Caton-Deschamps and Insall-Salvati Indices were used to evaluate patella alta. Trochlear dysplasia was assessed using the Dejour classification system. Skeletal maturity was graded based on the distal femoral and proximal tibial physes.

RESULTS: 326 knees (312 patients) met the above criteria. There were 149 females (45.7%) and 177 males (54.3%), with an average age of 19.6 years (range 9-62 years). Thirty-five patients (10.7%) were treated with surgery after the initial dislocation. All others were initially managed nonoperatively. Of these 291 patients, 89 (30.6%) had recurrent instability; 44 (49.4%) of which eventually required surgery.

A number of risk factors for recurrent instability were identified, including: younger age ($p<0.01$), immature physes ($p<0.01$), sports-related injuries ($p<0.01$), patella alta ($p=0.02$), and trochlear dysplasia ($p<0.01$).

CONCLUSION: Sixty-nine percent of patients with a first time patellofemoral dislocation will stabilize with conservative treatment. However, only 30% of patients under 20 years of age with trochlear dysplasia are successful with nonoperative management. In conclusion, trochlear dysplasia and younger age/immature physes are significant risk factors for recurrent patellar instability.

152. Mobile Compression Devices Are Efficacious for VTE Prophylaxis Following Total Joint Arthroplasty

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INTRODUCTION: Venous thromboembolic events (VTE) are the most common complication following total joint replacements. Recent literature shows use of a mobile compression device (MCD) is effective for VTE prevention, but efficacy is dependent on patient compliance. The purpose was to prospectively assess patient compliance with prescribed use of an MCD for VTE prophylaxis.

METHODS: Adults undergoing elective primary or revision knee/hip arthroplasty were prospectively enrolled. Patients were ineligible if they had prior surgery within three months, current deep vein thrombosis, history of pulmonary embolism, on chronic anticoagulation, or required prolonged immobilization postoperatively. Patients were stratified to standard or high risk anticoagulation therapy by hospital protocol. Standard risk patients were instructed to wear an MCD 23 hours/day for 10 days postoperatively. Compliance was measured two ways: objectively from the MCD hard drive which records usage and patient reported compliance two weeks postoperatively.

RESULTS: 747 joint replacements were enrolled (263 knees/484 hips). Four patients were missing compliance data due to malfunction/loss of MCD. Average daily use was 83% (19.92 hours). Patient compliance rates based on hourly usage were: 1.5% (11) used the device <12 hours/day (considered non-compliant); 14% (104) used the MCD >12, but <18 hours/day (considered somewhat compliant); 84.5% (628) used the device ≥ 18 hours/day (considered compliant). There was no difference in compliance based on gender ($p=0.710$) or primary/ revision surgery ($p=0.505$). Hip replacement patients were more compliant than knee replacement patients ($p=0.003$). 655 patients completed two week follow-up; 96% (629) reported compliance. Patient-reported compliance was higher than compliance captured on the MCD ($p<0.0001$). Incidence of VTE was very low (n=3; 0.4%). All patients with VTE were compliant.

CONCLUSION: Use of an MCD is excellent for VTE prophylaxis in primary and revision total joint arthroplasty, and is associated with high efficacy and patient compliance.

153. Locked Plating of Comminuted Distal Femur Fractures: Does Unlocked Screw Placement Affect Stability and Failure?

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OBJECTIVES: Locked plates provide greater stiffness, possibly at the expense of fracture healing. The purpose of this study is to evaluate construct stiffness of distal femur plates as a function of unlocked screw position in cadaveric distal femur fractures.

METHODS: Osteoporotic cadaveric femurs were used. Four diaphyseal bridge plate constructs were created using 13-hole distal femur locking plates, all with identical condylar fixation. Constructs included all locked (AL), all unlocked (AUL), proximal unlocked (PUL), and distal unlocked (DUL) groups. Constructs underwent cyclic axial loading with increasing force per interval. Data was gathered on axial stiffness, torsional stiffness, maximum torque required for 5^{o} external rotation, and axial force to failure.

RESULTS: Twenty-one specimens were divided into AL, AUL, PUL, and DUL groups. Axial stiffness was not significantly different between the constructs. AL and PUL demonstrated greater torsional stiffness, max torque, and force to failure than AUL, and AL showed greater final torsional stiffness and failure force than DUL (P-values<0.05). AL and PUL had similar axial, torsion, and failure measures, as did AUL and DUL constructs. All but two specimens fractured before medial gap closure during failure tests. Drop offs on load-displacement curves confirmed all failures.

CONCLUSIONS: Only the screw nearest the gap had significant effect on torsional and failure stiffness, but not axial stiffness. Construct mechanics depended on the type of screw placed in this position. This screw nearest to the fracture dictates working length stiffness when working length itself is constant and in turn determines overall construct stiffness in osteoporotic bone.

154. A Prospective RCT Comparing the SmartToe Device to K-Wire to Proximal Interphalangeal Joint Fusion: Early Results

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INTRODUCTION: Arthrodesis of the proximal interphalangeal joint (PIPJ) is the standard treatment for hammertoe deformity correction. The use of Kirschner wires is associated with problems such as rotational instability, loosening, pin track infections, and loss of alignment. Intramedullary implants statistically have superior outcomes when compared to Kirschner wires. The purpose of this study was to compare clinical and radiological outcomes of PIPJ arthrodesis using Kirschner wires and the Smart Toe intramedullary implant.

METHODS: Patients requiring PIPJ arthrodesis for hammertoe deformity were randomized into a control group treated with Kirschner wire fixation (15 patients-44 toes) and a study group treated with the Smart Toe implant (48 patients-85 toes). The primary endpoint was PIPJ fusion, and the secondary endpoints were pain scores, alignment, AOFAS scores, and SF-36 scores at 12 months. Significance was assessed at $p \leq 0.05$.

RESULTS: Both groups were similar with regards to age, sex, work status, and medical co-morbidities. At 12 months follow-up, the Smart Toe implant showed significantly higher AOFAS scores (mean 81.8) versus Kirschner wire (mean 74.4) ($p=0.012$). Smart Toe also had significantly lower rates of footwear pain at the end of 12 months (6/48) as compared to Kirschner wire (6/15) ($p=0.028$). The two groups had similar pain scores on the VAS ($p=0.532$), fusion rates ($p=0.324$), and malalignment ($p>0.999$). There were no statistically significant differences between the SF-36 scores for the two groups ($p=0.988$), nor the various components of the SF-36 scores. It should be noted that one patient expired as a result of pulmonary thromboembolism after surgery.

CONCLUSION: PIPJ arthrodesis with Smart Toe yields higher AOFAS scores and lower rates of footwear pain as compared to Kirschner wires at the end of 12 months. Both devices show similar pain scores, fusion rates, SF 36 scores, and malalignment rates at 12 months.

155. Data Driven Implant Design for the OTA/AO Type 43C3 Pilon Fracture

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INTRODUCTION: Based on a previous mapping study which detailed pilon fracture patterns, a distal tibial implant was designed to address common zones of comminution and primary fracture fragments in pilon fractures. The purpose of this study is to determine if this plate design properly addresses the most common OTA/AO type 43C3 fracture patterns.

METHODS: This anteriorly based implant features removable distal tabs which can buttress anterior plafond comminution, two kickstand screw trajectories which address the typical posterolateral and medial fragments, and a distal A to P screw pattern which allows for a raft above the plafond apex. All patients treated using this plate for the pilon fracture between September 2011 and June 2012 were prospectively enrolled. Injury radiographs and CT scans performed after application of external fixators and all postoperative radiographs were reviewed. An assessment of how the plate addressed the fracture pattern was performed for each patient.

RESULTS: Twenty consecutive OTA/AO type 43C3 tibial pilon fractures (11 R/9 L) were enrolled. The cohort consisted of 14 males and 6 females, with a mean age of 43 years (range, 23-61). There were three open fractures. Fourteen of the 20 fractures (70%) had an associated fibula fracture; all which were fixed through a separate incision. Eighteen of the 20 (90%) were consistent with the published Pilon Map. In the series, seven 3-hole, four 5-hole, five 9-hole, and four 13-hole pates were used. Seventy-eight percent of the kickstand screws were used (15 medial, 16 lateral) addressing the medial malleolar and/or posterolateral fragment. Thirty-nine of the 60 (65%) distal tabs for the anterior comminution of the fracture were utilized. Of the 20 cases, only 2 (10%) had separate medial buttress plates applied.

DISCUSSION: A new custom anterior pilon plate designed to address tibia pilon mapping data, consistently addressed the fracture patterns in OTA/AO type 43C3 tibial pilon fractures. This study provides the basis for a comparative outcome study.

156. Custom Knee Replacement Preserves Bone and Decreases Blood Loss

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INTRODUCTION: The purpose of this study is to compare two knee replacement (TKR) cohorts from a single surgeon: traditional TKR and a custom TKR with patient-specific instruments. The thickness of resected bone and implant, soft tissue releases, pre- and postoperative hematocrit (hct), transfusion rates, and pre- and postoperative coronal alignment were evaluated.

METHODS: This IRB approved prospective cohort study enrolled 83 traditional TKR (73 patients) and 22 Custom TKR (19 patients). The thickness of the femoral (distal and posterior medial/lateral) and tibial (medial/lateral) resections and soft tissue releases were recorded intra-operatively using the InVivolink software. Pre- and postoperative (day 3) hct were recorded. The pre- and postoperative leg alignments are determined from long leg x-rays.

RESULTS: Total thickness (sum of 6 measurements) of bone resected for Custom knees was 24% (12 mm) less than traditional ($p<0.001$). Total thickness of custom implants was 27% (17 mm) thinner than traditional ($p<0.001$). Total implant thickness was on average 9.1 mm greater than bone resection thickness for custom knees and 14.3 mm for traditional ($p=0.001$). Custom TKRs had less soft tissue releases than traditional TKRs ($p=0.046$). Average change in hct was 7.82 for custom knees and 9.64 for traditional ($p=0.039$). No custom TKR patients required transfusions; 4 (5%) traditional TKR patients required blood transfusions. The average coronal alignment was -0.23° for custom and 0.62° for traditional ($p=0.32$).

CONCLUSION: Custom TKR preserve more bone than traditional TKR by making the custom implant thinner, achieved by adding an extra chamfer cut which improves load distribution. The implant thickness of the custom TKR more closely approximates bone resection thickness. Fewer soft tissue releases are required with the custom TKR. Coronal alignment was similar in both groups. Transfusion rate and drop in hct were lower with custom TKR, likely due to not violating the femoral canal.

157. Higher Rates of Union in Older Patients with Type 2 and Type 3 Odontoid Fractures Treated with Teriparatide

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SUMMARY: Teriparatide may lead to higher union rates in type 2 and type 3 odontoid fractures. More studies with larger sample sizes including other contributing factors are needed to confirm this finding.

INTRODUCTION: High rates of morbidity and mortality are a major concern in older patients with odontoid fractures. Teriparatide is an anabolic drug approved for use in patients with osteoporosis at high risk for fracture. The only published evidence of teriparatide use in patients with odontoid fractures is a case report of three patients who went on to union after delayed healing. The purpose of this study was to determine the union rates in older patients with odontoid fractures.

METHODS: Between 2002 and 2011, 100 consecutive patients, age 50 years and over, with type 2 and type 3 odontoid fractures were treated at a single Level I trauma center, were followed in a single private practice, and retrospectively evaluated. Eleven patients were treated with teriparatide for osteoporosis and high risk for subsequent fracture. Radiographs were reviewed and fusion was determined by flexion/extension x-rays, CT scan, or both. Nineteen mortalities were excluded from the union analysis.

RESULTS: Of the 11 receiving teriparatide, there were 2 males and 9 females with an average age of 76 (range 63-90). In the non-teriparatide group, there were 29 males and 41 females with an average age of 74 (range 50-93). Patients treated with teriparatide had a higher rate of union (10/11, 90.9%) compared to patients who did not receive teriparatide (50/70, 71.4%).

CONCLUSION: Teriparatide may lead to higher union rates in type 2 and type 3 odontoid fractures. More studies with larger sample sizes including other contributing factors are needed to confirm this finding.

158. Effect of Optimizing Bone-Implant Contact on Hip Offset and Rotation with Three Contemporary Uncemented Metaphyseal Engaging Implants

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The wide variations in both the internal geometry of the proximal femoral neck and the extra-medullary orientation of the femoral neck require that cementless implant designs take into account both bone-implant contact and implant offset. The purpose of this study was to analyze the effect on offset and anteversion when three short stem implants had been placed to achieve optimum bone-implant contact.

The femurs of 30 patients were templated using a CT-based preoperative planning workstation with three different metaphyseal-engaging stem designs: straight tapered (Tri-Lock), anatomical (ABG II), and curved femoral neck preserving (ARC). Implants were positioned according to the manufacturers' design rationale. Five anatomical landmarks (levels) were identified from proximally to distally in the coronal, axial, and sagittal planes. At each of these five levels, the axial plane was divided into quadrants. Each quadrant was analyzed for contact, defined as implant-bone distance <0.5 mm. Once the optimum position of each implant was established, the vertical and horizontal offset and version (ante-or retro) were measured.

When comparing average "postoperative" anteversion to native "preoperative" anteversion, the ABG II increased the anteversion by 19.0º and the Tri-Lock increased anteversion by 9º. The ARC with a neutral neck most precisely restored native anteversion with a mean difference of 3.6º. A broad range of offsets resulted despite head/neck options. A majority of all implants had offset restored within 5 mm.

The results of this study indicate that if offset restoration is sought with non-modular neck uncemented implants that a compromise with regard to circumferential metaphyseal contact may be necessary.

MAOA BREAKOUT SESSION #11
Knee Arthroplasty
April 20, 2013

159. Operative Management of the Severe Genu Valgum Deformity in the Ellis-van Creveld Syndrome

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INTRODUCTION: The genu valgum deformity seen in the Ellis-van Creveld syndrome (EVC) is one of the most severe angular deformities seen in any orthopedic condition. It is likely a combination of a primary genetic-based dysplasia of the lateral tibial plateau combined with severe soft tissue contractures that tether the tibia into valgus. The purpose of this study is to describe our surgical management of 25 limbs with this condition.

METHODS: Surgery to correct severe genu valgum in 25 limbs in 14 patients due to EVC was performed by two different surgeons in the time periods from 1982-2001 (11 limbs) and 2008-2011 (14 limbs). Average age at surgery was 15.1 years. Clinical follow-up is ongoing (2 months-18 years). The surgical procedure was customized to each patient's deformity, but typically consisted of the following steps: (1) proximal and distal surgical decompression of the peroneal nerve, (2) radical release and mobilization of the severe quadriceps contracture and iliotibial band contracture, (3) proximal and distal realignment of the subluxed-dislocated patella, medial and lateral retinacular release, vastus medialis advancement, patellar chondroplasty, medial patellofemoral ligament plication, and distal patellar realignment or patellar tendon transfer with tibial tubercle relocation, (4) distal lateral hamstring lengthening-tenotomy and lateral collateral ligament release, (5) proximal tibial varus osteotomy with partial fibulectomy and anterior compartment release, and (6) occasional distal femoral osteotomy.

RESULTS: In all cases, the combination of radical soft-tissue release and bony osteotomy resulted in correction at the time of surgery. Follow-up is ongoing, but correction has been maintained in all cases to date. Complications consisted of 4 knee manipulations, 2 of which resulted in fatigue fractures of the distal femur, 1 peroneal nerve palsy requiring subsequent tendon transfer, 1 wound slough and hematoma requiring a skin graft, and 1 pseudo-arthrosis requiring removal of hardware and repeat fixation.

CONCLUSION: It is the authors' belief that failure to combine extensive soft-tissue release with bony realignment will routinely result in failure based on the described pathoanatomy.

160. Surface Area Differences Between Opposing Tibiofemoral Joint Surfaces Are a Risk Factor for Knee Osteoarthritis: A Prospective Cohort Study with 5-Year Follow-Up

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OBJECTIVES: Knee morphology is a key determinant of joint loading and knee osteoarthritis (OA) pathogenesis, but it is unknown whether individual size differences between paired joint surfaces influence joint loading or risk of OA. Our objective is to determine whether the ratio of femoral:tibial subchondral surface areas (SA) is a risk factor for symptomatic OA or radiographic progression.

METHODS: Patients from the Osteoarthritis Initiative (OAI) control and progression cohorts (N=1435, 581 male, 855 female, mean age 62.4±9.2) were analyzed at baseline and at five-years follow-up. Subchondral SA at baseline was determined by MRI, and SA ratio was calculated between the central weightbearing portion of the femoral condyle and the tibial plateau. This was compared to Kellgren-Lawrence (KL) OA grade (KL: 0 N=238, KL:1 N=149, KL:2 N=565, KL:3-4 N=490) and symptomatic OA status (KL:2+ and knee symptoms) at baseline and change in KL grade or JSW at five years. All analyses were repeated with and without KL:3-4 knees due to the significant deformation seen with severe OA.

RESULTS: Increased femoral:tibial SA ratios were associated with symptomatic OA status at baseline (mean 0.54±0.05 asymptomatic or KL<2; mean 0.67±0.11 symptomatic OA; $p<0.001$). Additionally, increased SA ratios were associated with greater KL grade ($R=0.34$, $p<0.001$) at baseline in addition to decreased JSW ($R=0.12$, $p<0.001$). An increased SA ratio was associated with progression to a higher KL grade at five years (total joint: $R=0.14$, $p<0.001$, medial: $R=0.15$ $p<0.001$, lateral: $R=0.11$ $p=0.001$).

CONCLUSIONS: Our findings indicate that relative size differences between paired tibiofemoral joint surfaces are associated with symptomatic OA in addition to progression of radiographic findings. An increased mismatch between paired femoral and tibial subchondral surface areas may affect load distribution at the cartilage surface, with some regions experiencing excessive loading conditions with resulting cartilage degeneration and symptomatic lesions. Our findings may be of particular importance to cartilage replacement therapy as constructs are often more sensitive to loading conditions than native cartilage.

161. Primary Total Knee Arthroplasty Blood Transfusion Trends and Characteristics Using the Nationwide Inpatient Sample

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INTRODUCTION: Transfusion rates in lower extremity arthroplasty patients have been reported to range from 11% to 69%. A push toward more conservative transfusion criteria has been emphasized for minimizing hospital acquired complications and costs. The purpose of this study was to use a national database to compare in-hospital mortality, length of stay, admission costs, and acute complications for total knee arthroplasty (TKA) patients with and without allogenic blood transfusion.

METHODS: The Nationwide Inpatient Sample database was utilized to query primary TKA cases (2000-2009), excluding cases with complicated pathology and trauma. Two study cohorts were formed: (1) patients transfused with allogenic blood products (n=540,270) and (2) patients not transfused (n=3,936,888). Multivariable regression was used to identify the effect of transfusion on outcomes.

RESULTS: During the study period, the overall allogenic blood transfusion rate in primary TKA patients was 12.1%. The rate increased ~5% from 2000 to 2009, and stayed constant around 13% from 2006 to 2009. Transfusion rates were higher in older patients (80-89 years, 21.4%; ≥ 90 years, 30.7%), blacks (19.6%), females (14.0%), Medicare patients (14.6%), and Medicaid patients (14.4%). Transfused TKA patients had a greater percentage of comorbidities than their non-transfused peers. The largest differences in comorbidity prevalence among transfused and non-transfused patients were: deficiency anemia (27.5% vs. 10.1%), renal failure (4.0% vs. 1.4%), chronic blood loss (3.7% vs. 1.4%), and coagulopathy (3.1% vs. 1.0%) ($p<0.001$). Adjusting for patient/hospital characteristics and comorbidity, transfused patients had a 22% greater likelihood of in-hospital mortality ($p=0.013$), 0.68 days longer length of stay ($p<0.001$), and $2,237 increased admission costs ($p<0.001$). Additionally, patients who received a transfusion had a greater risk of a postoperative infection (Odds Ratio, OR=2.35), pulmonary insufficiency (OR=1.60), venous thrombosis (OR=1.57), pulmonary embolism (OR=1.56), and pulmonary edema (OR=1.48) ($p<0.001$).

CONCLUSION: The allogenic blood transfusion rate increased between 2000 and 2009 in the United States. Transfusion has a considerable burden on patients and healthcare institutions, increasing in-hospital mortality, length of stay, admission costs, and acute complications.

162. Clinical, Functional, and Radiographic Outcomes Following PSI, CAS, and Manual TKA: A Short-Term Follow-Up Study

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INTRODUCTION: Patient-specific instruments (PSI) and computer-assisted surgery (CAS) are innovative technologies that offer the potential to improve the accuracy and reproducibility with which a total knee arthroplasty (TKA) is performed. It has not been established whether clinical, functional, or radiographic outcomes between PSI, CAS, and manual TKA differ in the hands of an experienced TKA surgeon. The purpose of this study was to evaluate clinical, functional, and radiographic outcomes between TKA performed with PSI, CAS, and manual instruments.

METHODS: 40 PSI, 38 CAS, and 40 manual TKA were performed by a single surgeon. The groups were similar in regards to age, sex, and preoperative diagnosis. The Knee Society Scoring System was used to evaluate patient clinical and functional outcome scores preoperatively and at one and six months postoperatively. Long-standing AP radiographs were obtained pre- and postoperative to evaluate mechanical axis alignment.

RESULTS: PSI, CAS, and manual TKA produced similar interval improvements in clinical and functional outcomes at both one and six months postoperative, although PSI tended to produce higher absolute Knee and Function scores at both one and six months postoperative. Postoperative mechanical axis alignment was not significantly different between PSI, CAS, and manual TKA (1.0, 2.0, and -0.2, respectively).

DISCUSSION: This study suggests that in the hands of an experienced arthroplasty surgeon, PSI, CAS, and manual TKA produce similar interval improvements in clinical, functional, and radiographic outcomes at short-term follow-up. These results may reflect the ability of an arthroplasty-trained academic surgeon to perform a TKA accurately with multiple technologies. These findings may also represent the lack of sensitivity and inability of commonly utilized evaluation tools, like plain radiographs and the Knee Society Scoring System, to adequately differentiate small differences in outcomes and limb alignment, if differences do indeed exist.

163. Custom Instrumentation is Superior to Standard Total Knee Arthroplasty Instrumentation When Evaluated with 3D Computed Tomography

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There is conflicting evidence whether custom instrumentation (CI) for total knee arthroplasty (TKA) improves component position compared to standard intramedullary instrumentation (SI). Prior studies have relied on long-limb radiographs (LLR) which are limited to two-dimensional (2D) analysis and are subject to rotational inaccuracy. We compared CI to SI in three-dimensions (3D) with computed tomography (CT) scans.

We prospectively evaluated a high-volume single-surgeon cohort of 77 TKA patients (51 CI, 27 SI) with postoperative CT scans using 3D reconstruction and contour-matching technology to preoperative imaging. Mechanical alignment of each component was measured in coronal, sagittal, and axial planes. Surgical details were recorded. Clinical outcome scores were obtained preoperatively, at three weeks, and at three months. Further follow-up and LLR will be reportable at one year.

The CI and SI groups were similar in preoperative knee deformity and clinical scores. Tourniquet time with CI (mean, 30 minutes) was significantly longer ($p<0.01$) than with SI (mean, 25 minutes). There were no significant differences in femoral notching or component overhang. There were two complications for CI (deep infection; arthrofibrosis) and one for SI (death). The magnitude of femoral component rotational error relative to the transepicondylar axis was significantly greater ($p<0.01$) for SI (3.3°, mean 0.8° internally rotated) than CI (1.2°, mean 0.2° IR). Femoral sagittal (mean, SI 1.5°, CI 1.7° flexion) and coronal (mean error, SI 1.7°; CI 1.3°) mechanical axis alignment were similar. The magnitude of tibial component coronal error was significantly greater ($p<0.01$) for SI (2.8°, mean 0.2° valgus) than CI (1.5°, mean 0.5° valgus). Posterior tibial slope was similar (mean, SI 7.0°, CI 7.8°). At three and six months, Knee Society Scores were similar, but SF-12 and Lower Extremity Activity Scores were significantly lower ($p<0.04$) for SI than CI.

When evaluated with CT, custom instrumentation improves femoral and tibial component position compared to SI. CT scan may be more accurate and complete than LLR in evaluation of component position.

164. Improved Postoperative Coronal Alignments in Total Knee Arthroplasty: A Case for Patient Specific Guides

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INTRODUCTION: Conventional total knee arthroplasty utilizes manual instrumentation (MI) consisting of jigs and medullary rods to achieve the goals of a neutral mechanical axis. Patient-specific guides (PSG) are an emerging technology in total knee arthroplasty (TKA), combining the ease of a simplified surgical technique with the potential for increased accuracy. The purpose of this study was to evaluate the early radiographic outcomes of patients who underwent TKA utilizing PSG compared to a similar group of patients who underwent TKA utilizing manual instrumentation (MI).

METHODS: We utilized long-leg standing radiographs to evaluate the postoperative coronal alignment in 347 patients. All measurements were performed by two reviewers who were blind to the method of instrumentation utilized. 168 TKA performed utilizing MI were compared to 179 TKA performed utilizing PSG. We compared the ability of each method to achieve a coronal alignment within 1º, 3º, and 5º of a neutral mechanical axis.

RESULTS: The average coronal alignment was 0.46º varus (SD=2.47º) for the PSI group and 1.21º varus (SD=3.8º) for the MI group indicating significantly better postoperative coronal alignment in the PSI group ($p=0.0276$). The PSI group achieved significantly more patients with alignment within 1º ($p=0.046$), 3º ($p<0.0001$), and 5º ($p<0.0001$) of a neutral mechanical axis than the MI group.

DISCUSSION: Patient Specific Guides are a promising new technology in TKA. PSG showed significantly better postoperative coronal alignments than MI in our patients that underwent TKA. This technology shows an ability to reduce outliers that is similar to prior generations of computer-assisted navigation (CAN); however, it does so without the added complexity and operative time that was found to be a fundamental weakness of CAN. Although clinical data is still pending, PSG may represent a step forward in the search for simpler techniques that yield improved surgical outcomes.

165. Improved Outcomes with Modern Modular Rotating Hinged Total Knee Designs Used for Primary TKA

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The authors report mid-term follow-up data of various modern modular rotating hinged knee implants for the treatment of the complex primary total knee.

INTRODUCTION: Historically, older hinged total knee designs had high rates of complications when used in primary and revision settings. The objective of this study is to look at the mid-term results of Modern RHTKA in patients undergoing complex primary TKA.

METHODS: Between 01/01/2001 and 09/01/2011, 60 knees in 54 patients were treated with four different modern RHTKA in the setting of complex primary total knee arthroplasty. The average age at the time of surgery was 68 years (range, 23-91 years) with an average follow-up of 35 months (range, 1-100 months). Indications included massive flexion contractures in patients with degenerative or inflammatory arthritis (11 knees), severe valgus deformity (10 knees), post-polio quadriceps deficiency (8 knees), distal femoral nonunion (6 knees), Charcot-type arthropathy with instability (6 knees), total hip resection arthroplasty necessitating the use of a total femur replacement (4 knees), comminuted distal femur fracture (3 knees), reimplantation after infection of a native knee joint (3 knees), and other reasons (post-traumatic OA, acute THA periprosthetic femur fracture, metabolic bone disease, chronic knee dislocation, and knee instability after tumor resection around the knee [10 knees]). We reviewed clinical and radiographic data to identify complication and failure rate and to report postoperative functional outcome.

RESULTS: Twelve knees experienced at least one complication (20%). A deep periprosthetic infection was the most common complication and reason for reoperation (8.3%). One patient sustained a periprosthetic femur fracture and another patient underwent synovectomy for patellar clunk syndrome. Knee Society knee scores improved from 33 (range, 0-83) to 80 (range, 35-100) postoperatively. Preoperative knee function scores improved from 16 (range, 0-70) to 39 (range, 0-100) postoperative.

No patient had to be revised for aseptic loosening of a component, but in one asymptomatic case, there was radiographic evidence of loosening of the tibial component at the bone-cement interface.

CONCLUSION: The mid-term results of modern RHTKA are promising as they seem to provide improved function and satisfactory fixation at mid-term. Infection continues to be a significant complication associated with their use and is likely related factors associated with this patient population.

166. Early Experience with the Biomet Oxford Unicompartmenteal Knee Implant – The First 5 Years

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INTRODUCTION: Patient selection, operative technique, and device design influence the early and late performance of unicompartmental knee arthroplasty (UKA). The introduction of the Oxford unicompartmental knee device to the American marketplace included requirements of training and early usage monitoring to insure improved consistency of results for medial degenerative joint disease (DJD).

METHODS: An IRB-approved retrospective review of Oxford knee usage for medial UKA evaluated 107 knees implanted between January 2006 and January 2011. Preoperative data included BMI, age, gender, Knee Society scores, and preoperative radiographic criteria. Post-operative data included Knee Society scores, radiographic analysis, and revision status.

RESULTS: 107 patients (49 male/58 female) with a mean age of 62 years (range: 34-90) and a mean BMI equal to 32 (range: 21-58) at the time of surgery. Preoperatively: 94% of patients had DJD isolated to a single compartment; 100% of patients had an intact ACL; 39% of patients did not have patellofemoral (P-F) DJD; 98% had a correctable varus deformity; and 93% had a fixed flexion deformity of $<10^{o}$. There were 11 revisions at the time of this report, which included: progression of lateral/P-F disease (2); dislocation of the mobile bearing (2); loosening (2); persistent pain/instability (3); subsidence (1); and a stress fracture of the medial tibial plateau. In addition, there are four pending revisions, and one patient is deceased. The mean pain, knee, and function scores were all significantly better ($p<0.001$) at the most recent post-operative follow-up visit when compared to preoperative data.

DISCUSSION: The senior author has seen both excellent and poor results with the use of this mobile bearing UKA. Major reasons for failure have been related to inconsistencies in surgical technique and, to a lesser degree, patient selection. Tibial component alignment was the most worrisome error. In general, the device has performed very well, even in patients with significant P-F disease, when implanted properly.

167. High Level of Residual Symptoms in Young Patients with TKA

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INTRODUCTION: Total knee arthroplasty (TKA) is among the fastest growing interventions in medicine with procedures incidence increasing the most in younger, more active patients. Global knee scores have a ceiling effect and do not capture the presence of difficulty or dissatisfaction with specific activities important to patients.

METHODS: A national multicenter study was designed to quantify the degree of residual symptoms and specific functional deficits in young, active patients (age 18-60) undergoing modern TKA at one of five total joint centers. To eliminate observer bias, data was collected by an independent, third party survey center with expertise in administering medical outcomes questionnaires for federal agencies.

RESULTS: Complete satisfaction and function data was collected in 661 patients (average age 54, 61% female) 1-3 years following primary TKA. The degree of overall satisfaction was relatively high with 90.3% of patients reported being satisfied with the overall functioning of their knee, 88.6% reported satisfaction with their ability to perform normal ADLs, and 91% were satisfied with the degree of pain relief. Only 66%, however, felt their knee felt *"*normal*"*, and the incidence of residual symptoms was surprisingly high with some degree of pain in 32.5%, stiffness in 40.8%, grinding or other noise in 33.4%, swelling or tightness in 32.5%, difficulty getting in and out of a car 37.9%, in and out of a chair 30.7%, and difficulty with stairs in 54%. Only 47% reported complete absence of a limp, and only 49.9% had participated in their most preferred sport or recreational activity in the past 30 days.

DISCUSSION AND CONCLUSION: When interviewed by an independent third party, a surprising percentage of young, active patients report residual symptoms and limitations following modern TKA.

168. Bacteria Exacerbate Polyethylene Particle-Induced Bone Loss at the Rat Tibia-Implant Interface

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INTRODUCTION: Infection leading to sepsis and osteolysis leading to aseptic loosening are problematic for many total joint arthroplasty patients. We evaluated the in vivo effects of polyethylene (PE) particles and/or Staphylococcus aureus on bone, using micro-computed tomography (μ-CT) in rats with tibial pins, hypothesizing that low-grade infection increases the bioreactivity of particles and leads to more osteolysis.

METHODS: Titanium pins were surgically implanted in the tibias of rats followed by injection of: saline (control), ultra-high molecular weight PE particles (150 ug), two different amounts of S. aureus (10 [SA10] or 1000 [SA1000] colony forming units), PE+SA10 and PE+SA1000 (n=8/group). Pin placement and bone re-growth were measured at 2 days (baseline) and 6, 12, and 24 weeks after surgery using μ-CT. 3D-analyses of the μ-CT data were performed on the trabecular bone and included the following structural indices: trabecular spacing (Tb. Sp) and bone volume fraction (BV/TV). Statistical analysis was done by ANOVA with repeated measures using SPSS.

RESULTS: For the PE treated rats, BV/TV was significantly less than baseline at week 12 ($p=0.013$) and week 24 ($p=0.036$). In SA10 treated rats, there was no significant change in BV/TV at any time point. When both were combined (PE+SA10), the rats showed a reduced BV/TV at week 6 ($p=0.05$) and week 12 ($p=0.04$), suggesting most of the effect was due to the PE particles. Unlike SA10 rats, the SA1000 treated rats had a lower BV/TV at all time points (6 weeks, $p=0.038$; 12 weeks, $p=0.038$; 24 weeks, $p=0.020$). These differences increased significantly when combined with PE (PE+SA1000, 6 weeks, $p=0.009$; 12 weeks, $p=0.012$; 24 weeks, $p=0.009$). Over time, Tb. Sp did not significantly change for the control group, whereas there was a statistically significant decrease at each time point in all the treated groups ($p<0.01$).

SUMMARY: We found that the higher S. aureus contamination of PE particles gave the greatest osteolytic changes over time. Future studies will examine the ability of sustained and controllable antimicrobial drug release from implant devices to prevent these changes.

169. Presence of Trochlear Dysplasia Associated with Less Progression of Tibiofemoral Osteoarthritis Following Patellofemoral Arthroplasty

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INTRODUCTION: Patellofemoral arthroplasty has been recommended for treating patients with advanced isolated anterior compartment osteoarthritis of the knee. However, long-term failure as a result of tibiofemoral degeneration has been reported to occur in up to 25% of patients. We carried out this retrospective review of the results of patellofemoral arthroplasty performed by a single surgeon at a single institution to determine factors associated with clinical patient outcomes and progression of tibiofemoral degenerative joint disease.

METHODS: Sixty-one patients with isolated patellofemoral osteoarthritis were treated with a patellofemoral arthroplasty by a single surgeon between 2003 and 2009. Fifty-nine patients were available for analysis with a mean follow-up of 4 years (range 2-8 years). Patients were evaluated by measuring range of motion and with the use of the Knee Society clinical rating system, the Tegner Activity Level scale, and the UCLA Activity Score. In addition, preoperative radiographs were reviewed for evaluation of patellofemoral and tibiofemoral compartmental osteoarthritis and presence of trochlear dysplasia, and postoperative radiographs were reviewed for evaluation of progression of tibiofemoral degenerative arthritis. Furthermore, multivariate statistical methods were applied to study factors that had potential to influence the final outcome.

RESULTS: There was no statistically significant association between age, gender, history of prior knee surgery, patellar height, patellofemoral osteoarthritis severity, patellar and femoral component size, or performance of lateral release with patient pain and function (as measured by the Knee Society scores) or progression of tibiofemoral joint osteoarthritis at final follow-up. Increased preoperative body mass index (BMI) was associated with lower postoperative Knee Society function scores ($p=0.03$). Patients with preoperative trochlear dysplasia had significantly less radiographic evidence of tibiofemoral joint osteoarthritis progression compared with patients without trochlear dysplasia at final follow-up ($p<0.0001$).

CONCLUSION: In this study, patients with preoperative radiographic evidence of trochlear dysplasia experienced less progression of tibiofemoral degenerative joint disease than patients without trochlear dysplasia at a mean follow-up of 4 years.

170. Continuous Passive Motion After Total Knee Arthroplasty: A Randomized Controlled Trial

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INTRODUCTION: Although continuous passive motion (CPM) machines are frequently utilized after total knee arthroplasty (TKA), their efficacy is questionable. We conducted a study to determine the efficacy of using a CPM machine following TKA. Postoperative outcomes of interest were swelling at, above, and below the joint line, postoperative drop in hemoglobin (as an indication of blood loss), self-reported pain scores, and active flexion and extension.

METHODS: This is a randomized, controlled trial. There were three treatment groups: CPM machine on and moving from the postoperative period and continuing throughout the patient's stay (as tolerated), CPM machine on and stationary for the first night and then moving throughout the rest of their stay (as tolerated), and no CPM use. There were 55, 51, and 54 subjects in each group, respectfully. Inclusion criteria consisted of any patient undergoing unilateral TKA. Exclusion criteria consisted of non-English speaking patients, those with a body mass index >40, and those without a preoperative range of motion of at least 16-81º. Subjects were followed during their postoperative stay up to their first follow-up in the clinic. Demographic and outcome data were collected from the patients' charts, and girth measurements were taken by nursing staff. Data were analyzed using a MANOVA test for all outcomes for each postoperative day and at final follow-up; individual ANOVA tests were used as needed. Significance was set at 0.05.

RESULTS: A power analysis was conducted, and it was determined that 50 subjects in each group would yield 81.74% power to detect significant differences in the dependent variables. There were no significant differences between any of the groups at any time, including preoperatively. Although the overall MANOVA test for the final follow-up was not significant, it is interesting to note that the ANOVA for length of stay showed a significantly longer stay for patients who received the stationary CPM on the first night ($p=0.005$).

CONCLUSION: The results of this study show that the CPM device provides no benefit to patients who are recovering from TKA.

171. Significant Decrease in Length of Stay and Significant Increase in Cost for Total Knee Arthroplasty in the United States

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INTRODUCTION: Total knee arthroplasty (TKA) is a highly effective surgery for patients with end stage knee disease. Although an increase in annual TKA utilization has been shown in previous studies, little has been published regarding length of stay (LOS) and cost data following TKA. The purpose of this study was to analyze the trends in LOS and cost according to payer status in the United States following TKA.

METHODS: Patients status post-TKA were identified; LOS, cost, and payer data from the Nationwide Inpatient Sample (1998 to 2005) were analyzed. Multivariate regression analysis was used to determine overall (all payer) changes in annual mean LOS and cost. Additionally, the change in mean LOS and cost by payer (Medicare, Medicaid, and private) was calculated for years 1998 and 2005. Cost data were not adjusted for inflation.

RESULTS: Between 1998 and 2005, there was a significant overall yearly decrease in the mean LOS (1998=4.40 days, 1999=4.36 days, 2000=4.31 days, 2001=4.26 days, 2002=4.09 days, 2003=4.01 days, 2004=3.91 days, 2005=3.80 days) and increase in the mean charges per case (1998=$21,240, 1999=$22,328, 2000=$23,641, 2001=$25,578, 2002=$28,158, 2003=$31,334, 2004=$33,874, 2005=$36,020) ($p<0.05$). After adjustment, the overall average decrease in LOS per hospitalization per year was approximately 0.1 days, and the average increase in cost per hospitalization per year was approximately $2,254 ($p<0.001$). Adjusted analysis of mean LOS and cost by payer revealed a significant decrease in LOS (Medicare, -.58 days; Medicaid, -0.77 days; private, -0.70 days; $p<0.001$) and increase in charges (Medicare, +$14,683; Medicaid, +15,593; private, +$14,319; $p<0.001$) from 1998 to 2005 for all payer types.

CONCLUSION: A significant decrease in LOS and increase in cost accompanied the increase in the volume of TKAs being performed in the United States for the years 1998-2005. These patterns are highly significant regardless of payer status.

MAOA BREAKOUT SESSION #12
Trauma
April 20, 2013

172. Why Do We Have "Lost to Follow-Up"?

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INTRODUCTION: The purpose of this study was to determine outcome and stated factors for patients not returning for further follow-up.

METHODS: Between 2002 and 2009, 380 consecutive skeletally mature patients with tibial plateau fractures underwent open reduction and internal plate fixation in one Level I trauma center and were followed in a single private practice. Short Musculoskeletal Function Assessment (SMFA) questionnaires were collected from the patient routinely at the 6 months, 1 year, and 2 year interval as long as patients returned for follow-up. Additional measurement of pain using a visual analog scale (VAS) and Range of Motion (ROM) was performed. All office records and telephone messages were reviewed for stated reasons for termination of follow-up.

RESULTS: The majority (56.5%) of the patients were male. Mean age was 47.9 years. The Body Mass Index (BMI) averaged 29.6 kg/m^2. 259 of 379 patients (68.3%) were followed until treatment was completed (PRN). One hundred and twenty patients (31.7%) terminated further follow-up. Patients in the 12 months and 24 months follow-up groups were older ($p=0.02$; $p<0.01$, respectively). The percentage of female patients increased with time of follow-up. In the group without SMFA questionnaires, 68.3% were male and 31.7% were female ($\chi^2<0.01$). At two years, 51.9% females and 48.1% males filled in the SMFA survey ($\chi^2=0.02$). Complaints about pain (VAS ≥ 3) were noticed in 21.7% of the patients terminating follow-up before the 6 months SMFA survey, 31.0% of the patients leaving after the 6 months SMFA survey, 40.4% of the patients leaving after the 12 months SMFA survey, and 41.4% of the patients returning for the 24 months SMFA survey ($\chi^2=0.06$). Regarding the comparison of SMFA subscores, significant improvements were found with time in all subscores ($p<0.05$), except arm and hand ($p=0.85$). A comparison of the SMFA subscores at the 6 or 12 months mark for those leaving treatment untimely with those being released from further office visits did not show significant differences.

CONCLUSION: Clinical follow-up remains an important part of postoperative surgical care and study design. Women and elderly patients tend to be followed for a longer period. The current study does not support the assumption that patients lost to follow-up have a different outcome using the SMFA score than patients returning until PRN.

174. Biomechanical Evaluation of Locking Plates vs. Iliosacral Screws in Vertically Unstable Sacral Fractures♦

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SUMMARY: A locking plate is a biomechanically superior construct for posterior fixation of vertically unstable sacral fracture when compared to the current gold standard of iliosacral screws alone.

METHODS: Comminuted Orthopaedic Trauma Association type 61-C1.3a2c5 sacral fractures were created in 20 4th generation composite hemipelvi models making two groups of 10 specimens each. The control group was fixed posteriorly with two 6.5 mm steel alloy cannulated screws into the body of both S1 and S2 while in the experimental group, a two-hole polyaxial locking plate was applied to the ilium and two 5.0 mm solid titanium alloy screws were directed into the body of S1 and S2. Weightbearing was simulated with axial load applied through the body of S1 and ipsilateral acetabulum using a hydraulically actuated load frame. Stiffness and load failure data were collected electronically and energy absorption was calculated.

RESULTS: Construct stiffness ($p=0.00086$), failure load ($p<0.0001$), and energy absorption ($p=0.00027$) all favored the locking plate group. Post testing inspection demonstrated lateral ilium wall fractures in the control group; however, no such fractures occurred in experimental group treated with a plate.

CONCLUSION: In this vertically unstable sacral fracture model, a locking plate increased construct stiffness, failure load, and energy absorption significantly when compared to the current gold standard of cannulated iliosacral screw alone.

175. Pelvic CT Scans Obtained Prior to Hip Reduction Results in Increased Time to Reduction, Cost, and Radiation Exposure

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INTRODUCTION: Delayed reduction of acetabular fracture dislocations has been associated with poor functional outcomes and increased risk for osteonecrosis of the femoral head. A pelvic CT scan is necessary to evaluate the details of the fracture, but should be obtained after reduction. The purpose of this study was to identify the rate at which CT scans were obtained prior to hip reduction in patients with acetabular fracture dislocations, and to determine the effect this had on time to reduction, cost, and radiation exposure.

METHODS: We identified 110 patients with acetabular fracture dislocations that were treated at our institution from 1/2005- 5/2011. The time of injury, arrival at the hospital, and hip reduction were recorded for each patient. Patients that received a pelvic CT scan prior to hip reduction were identified. Patients that were taken urgently to the CT scanner for other reasons and patients that had a failed attempt at hip reduction prior to CT scan were also identified.

RESULTS: Fifty-eight patients (52.7%) received a pelvic CT scan prior to hip reduction. One patient was taken urgently to the scanner for other injuries. Nine patients had an attempted hip reduction, but the hip was dislocated on the CT scan. In patients that underwent hip reduction before CT scan, the average time from arrival to reduction was 1.82 hours. In patients that had a pelvic CT scan prior to hip reduction, the average time from arrival to reduction was 3.29 hours. This difference in the time to reduction was significant ($p<0.001$). Thirty-one patients that underwent CT scan prior to hip reduction required a repeat CT scan. The cost of a pelvic CT scan at our institution is $1,159. The total cost of repeat CT scans from this study group was $35,929. Each patient that required a second CT scan received an additional 15 mSv of radiation.

CONCLUSION: Our study demonstrates the increased time to reduction, cost, and radiation exposure in patients that receive a pelvic CT scan prior to hip reduction. We advocate a multi-disciplinary approach and education to facilitate early identification of dislocation and reduction prior to CT scan in patients with these injuries.

176. Analysis of Plain Radiographs vs. CT Generated Images in the Diagnosis of Pelvic Ring Injury

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PURPOSE: The purpose of this study was to evaluate the accuracy of orthopedic surgeons at varying levels of training in the diagnoses of pelvic ring injuries using the AP, inlet, and outlet radiographs as compared to opaque volume rendering CT generated AP, inlet, and outlet images (also known as CT-generated radiographs).

METHODS: Blinded observers analyzed a series of 30 sets of pelvic plain radiographs and opaque volume rendering CT generated AP, inlet, and outlet images (OVRCT) of pelvic ring injuries using the classification as described by the Orthopaedic Trauma Association. The observers consisted of three groups: three junior residents, three senior residents, and three trauma-trained faculty. The diagnosis made by the treating traumatologist using plain radiographs, CT, and intraoperative findings served as the “Gold Standard”. The observers’ responses as compared to the “Gold Standard” were tabulated for statistical analyses.

RESULTS: The responses of the trauma-trained faculty were not significantly different ($P>0.05$) using the radiographic images as compared to using OVRCT in correctly classifying the pelvic fractures. However, both the senior and junior resident groups performed significantly worse ($P<0.05$) in correctly classifying the pelvic fractures using the radiographic images as compared to using OVRCT. Furthermore, the junior resident group performed significantly worse ($P<0.05$) than the senior resident group in correctly classifying pelvic fractures using the radiographic images as compared to using OVRCT.

CONCLUSION: When comparing the use of plain radiographs versus OVRCT generated images of pelvic ring injuries among different levels of surgeons, OVRCT images proved very beneficial for inexperienced surgeons and at least as good as plain radiographs for experienced surgeons in accurately classifying pelvic ring injuries. Therefore, the use of OVRCT generated images should be considered both for teaching purposes and for use in the clinical setting.

177. CT Reconstructed Radiographs vs. Plain Radiographs for Acetabular Fracture Classification in an Obese Patient Population

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INTRODUCTION: Acetabular fracture diagnosis is traditionally made with anteroposterior (AP) and oblique pelvic – Judet – plain radiographs. Plain radiographs, however, are subject to factors such as obesity that may impair diagnostic accuracy. New computed tomography (CT) reconstruction algorithms allow for simulated AP/Judet views that may eliminate the adverse effects of obesity on imaging. The purpose of this study is to evaluate the utility of CT reconstructed radiographs (CTRR) for classification of acetabular fractures in an obese patient population.

METHODS: Image sets for 16 patients with BMI >35 and acetabular fractures presenting to a Level I trauma center from June 2009 to June 2011 were created: set A, plain radiographs and set B, CT simulated radiographs. Three orthopedic trauma attendings, three orthopedic senior residents, and three orthopedic junior residents independently viewed these image sets and recorded their diagnosis which was compared to the intraoperative gold-standard findings. They reviewed a randomized set one month later to assess intra-observer reliability.

RESULTS: CT simulated radiographs (53.6%) were equal to plain radiographs (49%) for the diagnosis of acetabular fractures in all subjects ($p>0.05$); however, as experience level increased, so did performance with plain radiographs: attendings and senior residents performed significantly better than junior residents at evaluating plain radiographs ($p<0.05$), but all were equal on CTRR ($p>0.05$). Intra-observer reliability was substantial in all groups for both plain radiographs ($k=0.6$) and CT simulated radiographs ($k=0.7$).

CONCLUSION: When comparing the use of plain radiographs versus CTRR generated images in obese patients among different levels of surgeons, CTRR images proved very beneficial for inexperienced surgeons and at least as good as plain radiographs for experienced surgeons in accurately classifying acetabular fractures. CTRR use may be valuable in both teaching and clinical settings and, thereby, spare the patient unnecessary radiation exposure and discomfort.

178. Radiographic Measurement of Rotational Deformity in Pelvic Fractures: A Novel Method with Validity and Reliability Testing

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PURPOSE: Measuring pelvic ring displacement on plain radiographs has focused on gap and translational displacements, with assessments of rotational displacements being largely ignored due to difficulties in measurement. Our hypothesis is that rotational displacement can be accurately measured on plain film radiographs with good validity and reliability.

METHODS: A Sawbones model, validated in a separate study, was used. The models were fractured in a controlled fashion to simulate pelvic ring fracture patterns; anteroposterior compression (APC), lateral compression (LC) and vertical shear (VS). CT scans with standard and three-dimensional reconstructions of intact and injury models were obtained and used to create computer reconstructed radiographs (CRR) simulating standard AP, inlet and outlet views. A new technique of measuring axial rotation on the inlet view and sagittal rotation on the inlet/outlet views was devised. Written and diagrammed descriptions of the new rotational assessment techniques were then utilized by eight senior orthopedic residents and three fellowship-trained orthopedic trauma surgeons on the CRR of each model. These measurements were than assessed for interobserver reliability, and validity was tested by comparing the values obtained by the observers to the actual displacement as measured on CT scans.

RESULTS: CT scan measurements of rotational displacement correlated well with physical measurements of displacement on the model. Newly described techniques for axial and sagittal rotational measurements showed good validity with the majority of measurements falling within the 95% confidence interval and excellent reliability with average 95% confidence intervals of 1.8º and 3.4º, respectively.

CONCLUSION: We describe a new technique for measuring axial and sagittal rotational deformities which correlates well with CT measured displacements and shows excellent interobserver reliability. This measurement system could be utilized in future clinical studies to compare outcomes with residual rotational displacement.

179. Risk Stratification for Short-Term Morbidity and Mortality Following Hip Fracture Surgery

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INTRODUCTION: Prior studies have identified risk factors for poor outcomes following hip fracture treatment. We evaluated a validated method for stratifying patient risk in hip fracture patients.

METHODS: The American College of Surgeons National Surgical Quality Improvement Program database was used to identify 4,331 patients undergoing surgery for hip fracture between 2005 and 2010. Patient demographics, comorbidities, laboratory values, and operative characteristics were compared in a univariate analysis, and a multivariate logistic regression analysis was then used to identify independent predictors of 30 day morbidity and mortality. Weighted values were assigned to each independent risk factor, and used to create predictive models of 30 day morbidity, minor complication risk, major complication risk, and total complication risk. The models were internally validated with randomly partitioned 80% / 20% cohort groups.

RESULTS: Thirty-day mortality (MT) was 5.8% and morbidity (MB) was 29.1%. Patient age, especially age greater than 80 years, (MT: [OR 2.41 95% CI: 1.17-4.99] MB: [OR 1.43 95% CI: 1.05-1.94]) and male sex (MT: [OR 2.28 95% CI: 1.61-3.22] MB: [OR 1.26 95% CI: 1.03-1.54]) were associated with both increased mortality and morbidity. An increased ASA Class had the highest negative impact on total complication incidence in the scoring models. Additionally, complete functional dependence, active malignancy, patient race, cardiopulmonary disease, laboratory derangements, prolonged operating time, and open versus percutaneous surgery independently influenced outcomes. Risk scores, based on weighted models which included the aforementioned variables, predicted mortality ($p<0.001$, C-index 0.702) and morbidity ($p<0.001$, C-index 0.670) after hip fracture surgery.

CONCLUSION: We have developed an internally validated method for risk stratifying patients undergoing hip fracture surgery. Our model should be useful for identifying high risk individuals who need medical optimization, for obtaining informed consent, and for risk adjusted comparisons of outcomes between institutions.

181. Clinical Outcomes of Surgical Treatment of Multi-Ligamentous Knee Injury with Associated Peroneal Nerve Palsy

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OBJECTIVES: The purpose of our study is to report the clinical and functional outcomes of patients with multi-ligament knee injury and peroneal nerve palsy treated with multi-ligament knee reconstruction.

METHODS: The records of patients who underwent surgical treatment of multi-ligamentous knee injury with concomitant peroneal nerve palsy by the two senior authors between 1993 and 2009 were retrospectively reviewed. Inclusion criteria were: isolated knee injury, age ≥ 18 years, and minimum two-year follow-up. Patient demographics, injury mechanism, ligamentous/nerve injury patterns and treatment methods, and nerve recovery were recorded. Lysholm and IKDC outcome scores were obtained and compared to historical controls.

RESULTS: Twenty-six patients (23 males, 3 females) met inclusion criteria, including 9 complete and 17 incomplete peroneal nerve lesions. Mean follow-up was 6.25 years (range 2.0-18.1). The most common ligamentous injury patterns were ACL/PCL/FCL and ACL/FCL/PLC. Treatment for complete nerve palsy included: non-operative (1), neurolysis (1), nerve grafting (1), nerve transfer (1), tendon transfer (3), combination of nerve and tendon transfer (1), and below-knee amputation secondary to compartment syndrome (1). Treatment for incomplete nerve palsy included: non-operative treatment (13), neurolysis (2), nerve transfer (1), and combination of nerve and tendon transfer (1).

Mean Lysholm and IKDC outcome scores were 69.6 and 67.2 for the entire cohort, 76.8 and 68.0 for the complete peroneal nerve palsy group, and 65.4 and 66.7 for the incomplete palsy group ($p=0.28$, $p=0.91$). Incomplete peroneal palsy was associated with improved neural recovery: anti-gravity tibialis anterior muscle recovery was noted in 4/8 patients (50%) in the complete palsy group and 14/17 (82%) patients in the incomplete palsy group. At final follow-up, 40% of patients required an AFO. Multivariate analysis demonstrated that patients <30 years old had better outcomes ($p=.01$), whereas high-velocity injury ($p=.50$) and acute surgical treatment ($p=.44$) were associated with worse outcomes.

CONCLUSION: This study represents the largest reported cohort of patients with peroneal nerve palsy in the setting of multi-ligament knee injury. Functional outcomes in this patient group are worse in comparison to historical controls of patients with multi-ligamentous knee injury without concomitant peroneal nerve palsy. Return of tibialis anterior motor strength was not associated with improved Lysholm and IKDC scores. Therefore, the decreased functional outcomes are not solely related to peroneal nerve dysfunction.

182. Fix It or Discard It? A Retrospective Review of Functional Outcomes After Surgically Treated Patella Fractures Comparing Open Reduction Internal Fixation with Partial Patellectomy

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The goals of operative treatment of patellar fractures are to provide a congruous articular surface and restore the quadriceps extensor mechanism. To achieve these goals, open reduction and internal fixation (ORIF) is the operative technique of choice when anatomic reduction is possible. In comminuted fractures where some fracture fragments are unreconstructable, partial patellectomy (PP) offers an alternative means of restoring the extensor mechanism. The prognosis for these procedures is not clear; thus, the goal of this study was to compare functional outcomes of patients treated with ORIF to those treated with PP. We identified 73 patients with isolated displaced patella fractures who underwent operative treatment between 1/1/2002-12/31/09 at our institution. Of the 73 qualifying patients, 52 (71%) patients with isolated unilateral patella fractures with a minimum of one year follow-up agreed to participate and were enrolled in the study. Outcome instruments included the Knee Outcome Survey – Activities daily living scale, a general health assessment (SF-36 Health Survey), and a validated musculoskeletal assessment. Twenty-six underwent partial patellectomy and 26 underwent ORIF. The mean follow-up time was 35 months in the partial patellectomy group and 33 months in the open reduction internal fixation group. There were no significant differences in any of the functional outcome instruments including KOS-ALDS. There was also no significant difference in pain as assessed by VAS. There were more patients in the ORIF group who had an extensor lag greater than 5º at follow-up. This study demonstrates that functional impairment persists after operative treatment of patella fractures. Both ORIF and PP demonstrated similar final range of motion, functional scores, and complication rates. Despite its purported benefits, in this study ORIF did not result in superior outcomes compared to PP.

183. Patellar Tension Band Plate (TBP) in Comminuted Complex Patellar Fractures: Case Series

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BACKGROUND: Comminuted patellar fractures following blunt high energy trauma are difficult fractures to treat. Patellar height, articular congruity, marginal impaction, and locations of tendon/ligament attachments all serve biomechanical purposes within the knee extension mechanism. Tension band models have demonstrated their role in simple patellar fractures, while buttress plating can add stability to comminuted fracture patterns.

MATERIALS/METHODS: Retrospective CPT code search of two trauma fellowship-trained orthopedic surgeons identified 9 patients with blunt trauma induced comminuted patellar fractures treated with open reduction internal fixation with a patellar TBP construct. Final fixation consisted of a 2.7 mm quarter tubular plate or 2, 2.0 mm plates contoured to the anterior patella. The proximal and distal plate holes contained screws that were parallel to the articular surface. Additional comminution was internally fixed with small fragment screws or additional low profile contoured plates with small fragment screws.

RESULTS: All fractures radiographically progressed to union. No hardware loosening occurred radiographically or was appreciated intraoperatively during hardware removal (HWR). 5/9 patients had HWR secondary to irritation. 7/9 patients had full symmetrical knee range of motion without extension lag at 6 month postoperative visit, 9/9 had full motion by 1 year. 6/9 patients had at least mild continued patellofemoral (PF) pain after fracture union. Knee extension strength was 4/5 in 6 patients and 5/5 in 3 patients at 1 year.

CONCLUSION: In comminuted complex patellar fractures, patellar tension band plates were able to maintain reduction and all fractures progressed to union. Construct restored extensor mechanism with no extension lag and full range of knee flexion. Knee extension strength and PF pain are continued problems at one year follow-up.

184. Outcomes After Operative Management of Symptomatic Rib Nonunion

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INTRODUCTION: The vast majority of rib fractures are successfully treated nonoperatively, but certain patients develop symptomatic nonunion. Common complaints include pain with coughing, tenderness to palpation, and a sensation of clicking or jabbing with deep respiration. There is a paucity of literature on reconstruction of rib nonunions. The purpose of our study is to detail the surgical and functional outcome after rib nonunion reconstruction.

METHODS: Between November 2007 and July 2012, 7 patients who presented with 12 rib nonunions and disabling pain were treated by a single surgeon with reconstruction. Definition of a rib nonunion included clinical symptoms and a persistent fracture line on CT at least eight months after the original injury. Radiographs were assessed for fracture healing and clinical visits were reviewed for patient complaints and/or complications. Short Form 36 (SF36v2) and an author- derived patient questionnaire were mailed to the patients for assessment of their recovery.

RESULTS: Preoperatively, 6/7 patients were limited or could not work due to nonunion-related symptoms. Four of the 6 patients complained of a painful clicking, 5/7 complained of pain with respiration, and all 7 patients reported pain that woke them at night. The average length from injury to surgical rib reconstruction was 22 months (range, 9-51). At a mean follow-up of up to 19 months (range, 6-46), all 12 ribs went on to union with a mean time from reconstruction to union of 16 weeks (range, 12-24). At final follow-up, the mean SF-36 scores were similar to those of a normal population for the patients with greater than one year of follow-up (n=5). Four of the five patients with greater than 12 months follow-up were able to return to work and/or previous activities without limitations. Complications included one wound infection that resolved after irrigation and debridement and antibiotics. One implant was removed for symptoms.

CONCLUSION: Successful treatment of symptomatic rib nonunion is possible with good functional outcomes and a low complication rate.

MAOA BREAKOUT SESSION #13
Shoulder
April 20, 2013

185. Autograft Glenoid Reconstruction Combined with Tendon Transfers for Older Patients with Obstetric Brachial Plexus Injuries

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PURPOSE: We seek to report the outcome of shoulder reconstruction with glenoid bone grafting and tendon transfer in older patients with a history of obstetric brachial plexus injury (OBPI).

METHODS: Twenty-nine patients, 16 males and 13 females, with an average age of 12 years-old (range, 9-16 years-old), were included in this study. All patients had limited range of motion mostly secondary to shoulder internal rotation contracture with limited active and passive external rotation. The patients all displayed glenohumeral dysplasia with significant bony loss of the posterior glenoid associated with posterior shoulder subluxation or dislocation. Each patient underwent anterior shoulder release with lengthening of the subscapularis, combined with posterior glenoid reconstruction using iliac crest tricortical bone grafting. The lower trapezius was transferred to restore external rotation in every patient, while additional transfers to restore the rest of the rotator cuff function and/or deltoid function included: levator scapulae, teres major, upper/middle trapezius, upper serratus, and pedicled latissimus transfers. Patients were immobilized with a shoulder spica cast in abduction-external rotation for 6-8 weeks before rehabilitation. All patients had CT scan of the shoulder at the time of cast removal and one year after surgery.

RESULTS: At an average follow-up of two years (range, 16-39 months), all patients had significant improvement of shoulder external rotation from average -60^{o} preoperatively (range,-90 to -50^{o}) to an average 37^{o} (range, 15-70^{o}) ($P<0.002$), shoulder flexion from average 80^{o} (range, 50-120^{o}) to 130^{o} (range, 100-140^{o}) ($P=0.0015$), and shoulder abduction from average 70^{o} (range, 40-80^{o}) to 90^{o} (range, 70-110^{o}) ($P=0.002$). None of the patients lost active internal rotation compared to preoperatively. The aggregate Mallet score improved from an average 9.3 to 18.1 ($P=0.001$). Fourteen patients had partial and seven patients had complete healing of the bone graft at six weeks postoperatively. In all patients, the bone graft was completely healed with no signs of bone resorption, associated with restoration of the glenoid contour and reduction of the shoulder joint at one year of follow-up. All patients and their families were very satisfied with the outcome of surgery and would do it again.

Summary:

1. Shoulder reconstruction in older patients with OBPP is effective in improving shoulder function.
2. Bony reconstruction of the glenoid allows better restoration of the bony anatomy and reduction of the glenohumeral joint.
3. Tendon transfers allow restoration of the rotator cuff and/or deltoid function.

186. Structural Integrity After Rotator Cuff Repair Does Not Correlate with Patient Function and Pain: A Meta-Analysis of Level I and Level II Studies

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(Presented by William R. Hotchkiss, M.D., Dallas, TX)

Rotator cuff repair has been proven to reliably decrease pain and improve shoulder function. However, persistent tear after rotator cuff repair is not uncommon, and has been reported to be as high as 30-94%. There is still debate as to whether the structural integrity of the repair correlates with outcome. The purpose of this study was to perform a meta-analysis to correlate patient function and structural integrity of the rotator cuff after repair.

A comprehensive search of peer-reviewed literature was conducted for studies published prior to January 2012. Studies were included that reported at least one outcome measure after rotator cuff repair, and included a radiographic assessment of the structural integrity of the repair by magnetic resonance imaging (MRI), computed tomography arthrography (CTA), or ultrasound (US). Data extracted included patient demographics, tear size, type of repair, clinical outcome measures, and structural integrity of the repair. Statistical analysis was performed to compare outcomes in patients with based on repair integrity.

Thirteen studies met inclusion criteria, four were Level I and nine were Level II evidence. A total of 785 patients were included that underwent rotator cuff repair and had a minimum of one year follow-up. At final follow-up, 619 (78.9%) patients had intact repairs. On average, the UCLA, Constant and ASES scores increased and the VAS decreased in patients regardless of the structural integrity of the repair. Postoperative Constant scores were 9.03 points higher ($p=0.0009$) and UCLA scores were 2.95 points higher ($p=0.0004$) in patients with intact repairs. Postoperative ASES scores were no different in patients with intact repairs or retears ($p=0.25$). Postoperative VAS scores were 0.93 points lower in patients with intact repairs ($p=0.01$). Although these results are statistically significant, the differences are not clinically significant based on the validation of these outcome measures.

The results of this study suggest there is not a clinically significant difference in functional outcome or pain for patients that have undergone rotator cuff repair regardless of the structural integrity of the repair.

187. Triple Disruption of the Superior Shoulder Suspensory Complex

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Peter A. Cole, M.D. St. Paul, MN

OBJECTIVES: The purpose of this study is to report on a series of patients who sustained a triple disruption to the SSSC, their associated injuries, and functional outcomes of open reduction and internal fixation.

METHODS: A prospective scapula fracture database was established in 2002 with the approval of the IRB to record surgical and functional outcomes of patients undergoing ORIF for scapula fractures. Our study cohort met published and clearly defined operative criteria and consisted of all patients, greater than 17 years of age, who had more than two lesions to the SSSC.

RESULTS: Fifteen patients with greater than 2 disruptions (12 triple and 3 quadruple) were identified with a total of 48 disruptions. There were 14 scapula neck fractures (14 operatively treated), 8 clavicle fractures (4 operative), 6 AC separations (5 operative), 10 coracoid (7 operative), and 10 acromion fractures (8 operative). Associated injuries outside the shoulder girdle occurred in 100% (15/15). Rib fractures were present in 87% (13/15) with a mean of 4.5 ribs fractured (range 1-10) per patient. A fracture of the spine occurred in 53% (8/15) of which one complete spinal cord and three complete nerve root lesions. Traumatic brain injury was documented in 67%. Thirteen patients (87%) sustained single or multiple nerve injuries. Thirteen nerve lesions were noted distal to the brachial plexus, and 9 nerve lesions were at or proximal to the brachial plexus. Outcomes were obtained on 13 patients (87%) with a mean follow-up of 30 months (range 7.5 to 75 months). Dash scores averaged 14.2 (range 0-45). Mean range of motion, when expressed as the percentage of injured ROM over contralateral ROM, was 94% forward flexion, 91% abduction, and 76% external rotation. Mean strength measured by a hand held dynamometer and expressed as the percentage of injured over contralateral was 62% forward flexion, 60% abduction, and 66% external rotation.

CONCLUSION: Patients who sustain triple and quadruple lesions to the SSSC who undergo operative stabilization of displaced fractures, demonstrated satisfactory functional outcomes.

188. A Comparative Analysis of Stability of Initial Management of Humerus Fractures

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BACKGROUND: Humeral fractures are approximately 1-3% of all fractures. A popular standard of care is to place humeral fractures in some form of splint while awaiting definitive management. The purpose of this study was to identify the method of initial external support to the upper arm that offers the greatest stability in a cadaveric transverse midshaft humeral fracture model.

METHODS: Seventeen cadaveric humeri were evaluated. Transverse midshaft osteotomies were made to simulate transverse midshaft humeral fractures. Each humerus was then randomly and sequentially placed in the followings splints: coaptation splint + posterior splint, coaptation splint with chest piece continuation, posterior splint alone, sling and swath, coaptation splint alone, and functional brace. The cadavers were placed in a seated position and anterior-posterior images were taken prior splint application. Splints were then applied, repeat imaging obtained, and the upper extremity was manually moved through a 20º flexion and extension arc. Images in the splint after simulated motion were then obtained. The process was repeated for each form of immobilization. The fluoroscopic images were then assessed for angulation, shortening, and displacement of the fracture.

RESULTS: The sling and swath performed poorly in angulation and rotation compared within all other forms of immobilization ($p<0.001$; mean angulation 15.9º valgus; 100% with rotational deformity). Trends in the data revealed that the coaptation splint with a chest piece and the posterior splint alone improved angulation of the fracture while the coaptation splint alone and functional brace were more likely to displace the fracture, but these differences did not reach statistical significance.

CONCLUSIONS: A traditional coaptation splint alone may not be the best splint to support and maintain humeral shaft fracture alignment. A sling and swath is inadequate for initial support of such fractures. Further research is needed to address stability and subsequent comfort.

189. Associated Capitellum and Elbow Ligament Injuries in Isolated Type 1 Radial Head Fractures Based on Magnetic Resonance Imaging

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BACKGROUND: Although the majority of isolated Mason type 1 radial head fractures have reportedly good clinical outcomes, it has been our experience that there is a clinical subset who continues to have a chronic elbow ache and pain with lifting. As advanced imaging has become more common in orthopedic practice, there is a heightened awareness of associated injuries and need to define such relationships. Using magnetic resonance (MR) imaging, we sought to further describe the incidence of and characterize associated elbow injuries with special attention to the degree of insult to the capitellum and elbow ligaments.

METHODS: Sixteen patients with 16 Mason type 1 radial head fractures underwent MR imaging of the affected elbow after being diagnosed by physical examination and orthogonal plain radiographs.

RESULTS: The incidence of associated elbow injuries was 100%. Capitellar injuries occurred in 81% of patients. Of these, chondral injury was present in 31% and evidence of subchondral fracture in 6%. Medial collateral ligament (MCL) injury occurred in 88% of patients, including four complete tears (25%), and in 85% of patients with capitellar injuries. 100% of elbows had lateral ulnar collateral ligament (LUCL) injury with four complete tears. No loose bodies were identified.

CONCLUSIONS: The incidence of capitellar and MCL injury is higher than previously reported in patients with isolated Mason type 1 radial head fractures. Patients diagnosed with this seemingly benign injury should be followed more closely initially and evaluated with advanced MR imaging if there is a failure of motion progression or persistent pain. The long-term clinical outcome of such patients with osteochondral damage of the capitellum should be investigated.

190. Comparison of Tension Band vs. Plate Osteosynthesis in Transverse Olecranon Fractures: A Matched Cohort Study

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INTRODUCTION: Fixation of displaced olecranon fractures is usually indicated to restore function. Isolated, displaced, transverse fractures with no comminution are amenable to fixation with either a tension band (TB) construct or a plate. But there have been no studies published to compare the outcomes of these techniques. We hypothesized that there would be no differences in outcomes between TB and plate fixation.

MATERIALS AND METHODS: We retrospectively reviewed our experience using TB and plate fixation in isolated, displaced, transverse olecranon fractures from 2004-2011. Ten patients from each cohort, matched according to age and length of follow-up, were assessed through review of medical records, physical examination, AP and lateral radiographs of the elbow, and functional scoring using the Mayo Elbow Performance Score (MEPS) and the Quick Disability of the Arm, Shoulder, and Hand (QuickDASH/QDASH). Differences in range of motion (ROM), arthrosis, complications, and functional scores were compared using independent t-tests.

RESULTS: At an average follow-up of 4.1 years (range 1.1-8.5 years), there were no significant differences in length of follow-up, flexion, extension, arthrosis, and MEPS and QDASH scores (all $p>0.05$). There were no infections or nonunions in either group. One of 10 patients in the plate cohort had undergone removal of hardware compared to 4 of 10 in the TB cohort, and this difference trended to significance (10% vs. 40%, $p=0.12$). Three of 10 patients in the plate cohort reported symptomatic hardware compared to 7 of 10 in the TB cohort, and this difference also trended toward significance (30% vs. 70%, $p=0.07$).

CONCLUSIONS: Both TB and plate fixation are viable options for treatment of displaced transverse olecranon fractures. While there were no significant differences in clinical outcomes, our study suggests that plate fixation is associated with less symptomatic hardware and fewer repeat operations for removal of hardware; a difference that trended towards significance. Larger, randomized studies are needed to further investigate the differences between these two techniques.

191. Effect of Rotator Cuff Tears on Genomic, Histologic, and Biomechanical Properties of the Long Head of the Biceps Tendon

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INTRODUCTION: Pathologic changes to the long head of the biceps (LHB) can occur in the setting of rotator cuff (RC) tears. The purpose of our study was to characterize the effect of RC tears on the genomic, histologic, and biomechanical characteristics of the LHB tendon.

MATERIALS AND METHODS: After IRB approval, the intra-articular portion of the long head of the biceps tendon was collected from primary arthroplasty procedures with intact and torn RCs (n=6 per group). Samples were fixed, embedded in paraffin, and stained with haematoxylin and eosin (H&E) and Alcian blue stains. A second collection (n=6 per group) was also completed, with a proximal portion of the tendon stored in RNA later before assayed with a PCR array analyzing a panel of 84 genes associated with extracellular matrix and adhesion molecules. Each tendon was imaged with MicroCT for calculation of LHB tendon cross-sectional area and then mounted to two soft tissue clamps on a materials testing frame (MTS Insight) and pre-loaded with a 1.0N axial force along the long axis of the tendon for biomechanical testing. Tendons were preconditioned, subjected to a stress-relaxation test, and loaded to failure.

RESULTS: Collagen fiber alignment was maintained in RC-intact compared to visible disorganization in RC-deficient tendons. RC-deficient shoulders had significantly higher proportion of tissue staining positive for Alcian Blue compared to RC-intact ($P<0.05$). RC-deficient tendons had a lower tensile modulus (15.33±12.9 MPa) compared to RC-intact tendons (26.67±5.8 MPa). RC-deficient shoulders had lower peak stress and equilibrium stress (207.6±182.6 kPa and 46.7±45.9 kPa, respectively) compared to RC-intact shoulders (401.2±156.0 kPa and 104.8±20.1 kPa, respectively), as derived from stress relaxation tests. Genetic PCR extracellular and adhesion array analysis is awaiting final statistical analysis.

CONCLUSION: In the presence of rotator cuff tears, LHB tendons undergo histological and biomechanical degeneration. An intact RC may provide a protective environment from development of tendon pathology.

192. Evaluation of Suture Slippage with Knotless Suture Anchors in Rotator Cuff Repair

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INTRODUCTION: Knotless suture anchor are commonly used as implants for rotator cuff repairs. The experiment compared the amount of suture slippage occurring between two types of knotless suture anchors during cyclic loading in human cadaveric proximal humeri. Increased slippage may lead to loss of repair of the rotator cuff.

METHODS: Six fresh frozen human shoulder specimens (53.3 ± 5.7 years) were utilized to determine the suture slippage characteristics of two knotless suture anchors in a simulated rotator cuff repair model. The group 1 anchors used an internal ratcheting mechanism while the group 2 anchors were modular in nature and created an interference fit around the suture by impacting the anchor into bone. For each shoulder, one of each anchor type was inserted into the greater tuberosity. In all instances, the distance between the anterior and posterior anchors was 2 cm. The axis of pull was co-axial with the anchor representing a worst-case loading scenario. Mechanical testing comprised of tensile loading followed by tension to failure.

RESULTS: The group 1 anchors survival rate was significantly higher compared to the group 2 anchors (100% vs. 17%, $p=0.0043$). Group 2 anchors resulted in significantly more gapping. Maximum gapping in the group 2 anchors (11.2 ± 4.7 mm) was statistically significantly higher compared to the group 1 anchors (1.9 ± 0.5 mm, $p=0.004$). The failure mechanism for all group 1 anchors was suture breakage while the interference mechanism failed in all tested samples. Namely, the suture and internal locking mechanism pin disassociated from the anchor locking into the bone.

CONCLUSION: The group 1 anchors displayed less slippage compared to group 2 anchors in this worst-case model suggesting they may allow for less gap formation at the repair site during the healing phase. This model also showed that group 1 may have a decreased rate of early catastrophic failure compared to group 2. Overall, knotless suture anchors using an internal racketing locking mechanism reported significantly less suture slippage compared to knotless anchors using interference fit locking technique.

193. Traumatic Rotator Cuff Tears in Patients Under the Age of 25

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BACKGROUND: Traumatic rotator cuff tears in patients under the age of 25 are very rare events, with few reports in the literature. Shoulder pain in this patient population is routinely attributed to instability or subacromial impingement syndrome, and the diagnosis of a rotator cuff tear is often overlooked due to the patient's age.

METHODS: A retrospective review was performed of all patients under the age of 25-years-old that had undergone a rotator cuff repairs over a nine-year period. The medical record was reviewed to confirm the diagnosis of a traumatic supraspinatus tear. Patient data analyzed included mechanism of injury, delay in treatment, official MRI diagnosis, range of motion, strength, and patient satisfaction.

RESULTS: Nine patients under the age of 25 were identified with a post-traumatic supraspinatus tear as visualized during diagnostic shoulder arthroscopy representing 0.33% (9/2727) of all rotator cuff repairs performed over a nine-year period. The average patient age was 19.1 (+/-3.7) years, range 13-25 years. The official MRI failed to diagnose a rotator cuff tear in 50% of the patients. The time from injury to surgery was an average of 6.6 (+/-4.4) months. All tears were arthroscopically repaired. 66.7% (6/9) of the patients demonstrated concomitant anterior instability pathology. There were no reported complications. At latest follow-up (range 4-30 months), all patients reported minimal to no shoulder pain and were tolerating strenuous work, activities, and sports without significant complaints. All patients demonstrated nearly symmetrical active and passive range of motion with near normal strength compared to the contralateral side. All patients remained satisfied with their functional outcomes.

CONCLUSION: This is the largest reported series of traumatic rotator cuff repairs in patients under the age of 25. Even with advanced imaging, the diagnosis of a rotator cuff tear can often be missed in this patient population. While clinical outcomes can be excellent, care must be taken to broaden the diagnostic differential in young patients with post-traumatic shoulder pain.

194. Biomechanical Evaluation of Rotator Cuff Repair with Biceps Tendon Augmentation

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PURPOSE: Aim of the study was to biomechanically analyze rotator cuff repair with biceps augmentation to determine its effects on repair strength and footprint contact area.

METHODS: A full thickness, single tendon rotator cuff tear of the supraspinatus was created in 14 matched cadaveric shoulders. Tendon tears were standardized amongst paired shoulders and repaired in an open fashion. Dual anchor, single row rotator cuff repair with and without long head of biceps tendon augmentation was performed. Modified mason allen stitches were used in both repair techniques. The biceps augmentation technique used a tenotomised biceps tendon which was directly incorporated into the repair. The cadaveric shoulder was placed under a simulated physiologic load. Electronic contact pressure and area data was recorded at time of completion of the repair. The repairs then underwent a standardized incremental loading profile to failure. Gapping at the repair site and ultimate load to failure of the repair was recorded. Our data was then reviewed and statistically analyzed.

RESULTS: The resistance of the augmented repairs to stretching out was on average 7% less than the standard repairs at gapping of 3 mm, 4 mm, and 5 mm. However, this difference between the two repair techniques was not statistically significant (range: 2-12%, p=0.818). Statistically significant differences were observed in the ultimate load to failure and footprint contact area. The ultimate load to failure was 16% greater in the augmented group compared to the standard repairs (651±67N vs. 560±54N, p=0.0359). The area of contact between the rotator cuff and the humeral footprint was 22% larger in the augmented group compared to the standard repairs (152±17 mm^2 vs. 187±20 mm^2 , p=0.0442).

CONCLUSIONS: There is no statistical difference between the repairs at early incremental loading to produce gapping of 3 mm, 4 mm, and 5 mm.

The biceps augmented repair had a higher ultimate load to failure when compared to standard repair. Biceps augmentation increased the contact area between the rotator cuff tendon and the humeral footprint.

195. Arthroscopic Decompression at the Suprascapular Notch: A Radiographic and Anatomic Roadmap

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INTRODUCTION: Arthroscopic suprascapular nerve decompression (ASSND) is a challenging procedure. The purpose of this study was to determine which preoperative imaging modality most accurately reflects the distance from the acromion to the suprascapular notch. Additionally, this study describes the average distance from standard arthroscopic portals to the suprascapular notch (SSN).

METHODS: Ten matched pairs of cadaveric shoulders were imaged with x-ray, CT, 3D CT, and MRI. Distances were measured from the anterolateral border of the acromion to the lateral border of the SSN. ASSND was then performed and the portal distances from the skin to the lateral border of the SSN were recorded for an anterolateral, posterolateral, and suprascapular nerve portal. All soft tissue was removed and bony measurements were performed. Spearman Correlation Coefficients were used to determine correlation between the radiographic and anatomic measurements. Bland-Altman plots were used to evaluate measurement agreement.

RESULTS: Mean anatomic and radiographic measurements to the lateral SSN were: anatomic 64 mm (SD=6.2), x-ray 65 mm (SD=9.0), CT 45 mm (SD=3.9), 3D CT 64 (SD=5.4), and MRI 48 mm (SD=8.6). Spearman Correlation Coefficients showed 3D CT to have the highest correlation (SCC=0.90, $p<0.001$), followed by MRI (SCC=0.75, $p<0.001$), CT (SCC=0.66, $p=0.01$), and x-ray (SCC=0.41, $p=0.1$). Bland-Altman plots demonstrated that 3D CT and x-ray have the highest agreement with the direct anatomic measurements. Lateral arthroscopic portal measurements averaged 25 mm longer than bony measurements. For the arthroscopic portal measurements, the mean distances from the skin to the SSN for the anterolateral, posterolateral, and suprascapular nerve portals were 89, 88, and 49 mm respectively.

CONCLUSION: 3D CT is the most accurate preoperative imaging modality for defining the distance to the suprascapular notch. This and knowledge of the average distance from standard arthroscopic portals to the SSN may provide assistance when performing an ASSND.

196. Arthroscopic Capsulolabral Reconstruction for Posterior Instability in the Adolescent Shoulder

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INTRODUCTION: Unidirectional posterior shoulder instability is a relatively uncommon injury compared to anterior instability. Recent studies have reported on the outcomes of surgical treatment for posterior instability in the general athletic population. However, there remains little data on the outcome of surgical treatment in an adolescent population, which is at known higher risk for failure following treatment of anterior instability. Therefore, the purpose of this study was to determine (1) the clinical outcome for pain, function, and instability, and (2) to define variables associated with outcome in patients <18 treated with arthroscopic capsulolabral reconstruction for posterior instability of the shoulder.

METHODS: We retrospectively reviewed 22 athletes (25 shoulders) with unidirectional recurrent posterior shoulder instability treated with an arthroscopic posterior capsulolabral reconstruction from 2002 to 2010. The study group included 22 males and 3 females with a mean age of 17 (range, 14-17.9). Patients were evaluated at a mean of 63 months postoperatively (range, 24-115 months) with the ASES scores for pain, stability, and function, as well as Marx activity scores. In addition, the posterior inferior bony and chondrolabral glenoid version were measured on preoperative MRI. Statistical analysis was performed for continuous and categorical variables with significance set at alpha=0.05.

RESULTS: The overall mean postoperative ASES and Marx scores were 74.3 (SD 20) and 14.8 (SD 3.2) respectively. Twenty-three shoulders were stable at the time of final follow-up (92%). Two patients had traumatic recurrent episodes of posterior instability. Return to sport at the same level was achieved in 67% of athletes. Overall postoperative ASES scores were significantly higher in male patients (77.6 vs. 50.5; $p=0.04$), those with traumatic injuries (77.7 vs. 49.4; $p=0.03$), and in contact athletes (80.3 vs. 50.3; $p<0.01$). Postoperative Marx scores were significantly higher in male patients (15.4 vs. 10.3; $p<0.01$). Increased bony or chondrolabral retroversion did not appear to influence outcome.

CONCLUSION: Arthroscopic capsulolabral reconstruction is an effective treatment for symptomatic unidirectional posterior glenohumeral instability in an adolescent population. In this series, outcomes were improved in males, contact athletes, and patients with a traumatic etiology of posterior glenohumeral instability.

197. Biomechanical Comparison of an All Soft-Tissue Technique vs. Interference Screw Fixation for Subpectoral Tenodesis of the Long Head of the Biceps

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J. Gary Bledsoe, Ph.D.	St. Louis, MO
Adnan Cutuk, M.D.	St. Louis, MO

PURPOSE: The purpose of our study was to biomechanically compare a long head biceps tenodesis using the all soft tissue biceps sling technique to that with an interference screw.

METHODS: Six paired fresh frozen shoulder and humerus specimens were separated into two groups. One group utilized an all soft-tissue biceps sling technique for tenodesis. The other group used the interference screw technique for subpectoral tenodesis of the long head biceps tendon (LHBB). Both groups were tested biomechanically using an MTS machine. All specimens were sequentially loaded for 200 cycles and initial and final displacements were measured. Subsequently the specimens were loaded to failure and both the load and mode of failure were recorded.

RESULTS: One specimen in the biceps sling technique and two specimens in the interference screw technique failed before completing all 200 cycles. The mean displacement of all specimens undergoing the sling technique was significantly less than that of the interference technique at 2.95 mm (±0.80) versus 5.03 mm (±1.08) ($p<0.05$). The biceps sling technique had a higher mean ultimate failure load of 216.9 N (±91.6) compared to the interference screw technique that had a mean of 171.7 N (±101.4), although this was not statistically significant ($p=0.63$). In the interference screw technique, 4 specimens failed at the tenodesis site either by tearing or complete pullout, while 2 failed at the biceps myotendinous junction. In the sling technique, 4 specimens failed at the biceps myotendinous junction, while 1 specimen tore at the tenodesis site, and 1 detached the pectoralis tendon insertion from the humerus.

CONCLUSION: The biceps sling technique is biomechanically comparable to the interference screw technique for subpectoral LHBB tenodesis and, in fact, had less displacement with cyclic loading.

MAOA BREAKOUT SESSION #14
Tumor/Basic Science
April 20, 2013

198. Adamantinoma of Long Bones

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Franklin H. Sim, M.D.	Rochester, MN

PURPOSE: Investigate the clinical presentation and oncological outcomes of patients with adamantinoma.

METHODS: Forty patients treated between 1939 and 2011. Retrospective review. Follow-up data included clinical, radiographic, complications, local recurrence, metastasis, and survival. Minimum follow-up 2 years, mean follow-up 12.8 years (range, 12-469 months).

RESULTS: Forty cases: 28 tibia, 6 tibia and fibula, 2 ulna, 1 femur, fibula, humerus and radius. 64% presented with pain and swelling. Mean age was 13 years (7-79 years). Thirty-four patients treated initially with limb sparing surgery and eight with an amputation. Survival rate was 78.6%. Eight patients had recurrent disease and five required amputation, nine patients developed metastasis. Nine patients died of disease at mean of ten years.

CONCLUSIONS: En bloc resection with limb salvage is the treatment of choice. If a local recurrence occurs, high risk of secondary amputation. Patients require long-term follow-up for evidence of local recurrence or metastases.

199. Osteoid Osteomas of the Foot and Ankle: A 20-Year Experience

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Doris E. Wenger, M.D. Rochester, MN
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INTRODUCTION: Although osteoid osteomas (OOs) are the most common benign bone tumor in the foot and ankle, previous studies of treating these lesions in the foot and ankle are limited to case reports. Classically, patients complain of pain that is worse at night and relieved with non-steroidal anti-inflammatories (NSAIDs). We present the largest cohort of patients treated for an OO of the foot and ankle reported to date.

METHODS: We retrospectively reviewed all patients who underwent a surgical or an interventional radiologic procedure with a histologically confirmed of an OO of the foot and ankle from 1990 to 2010.

RESULTS: Thirteen patients (12 male, 1 female), had an OO located in the foot or ankle. All of the patients reported foot or ankle pain which was limiting their daily activities. The most common location was the talus (n=5). Ten lesions were treated surgically, three were treated with RFA. One patient in the RFA group underwent a repeat RFA due to recurrence of their OO four months following the initial procedure. One patient treated surgically underwent a removal of painful hardware one year after the initial procedure. Surgical patients required three weeks of restricted weightbearing, while patients treated with RFA had no weightbearing restrictions following the procedure. At last follow-up, on average six months from surgery, all patients reported complete pain relief, and 100% had returned to their previous activities, including sports.

DISCUSSION: Surgical curettage and RFA provided excellent relief of symptoms in patients with an OO in the foot and ankle. Currently, we recommend RFA for lesions with diagnostic imaging. The major contraindication to RFA is a lesion with a close anatomic proximity (<1.5 cm) to a major neurovascular bundle. The proximity of the lesion to the articular cartilage should also be carefully inspected with care to select the treatment option that will cause the least amount of articular cartilage damage.

200. Rigidity of Fixation Affects Fracture Healing in the Murine Model

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*Cesar S. Molina, M.D. Nashville, TN
Jonathan G. Schoenecker, M.D. Nashville, TN

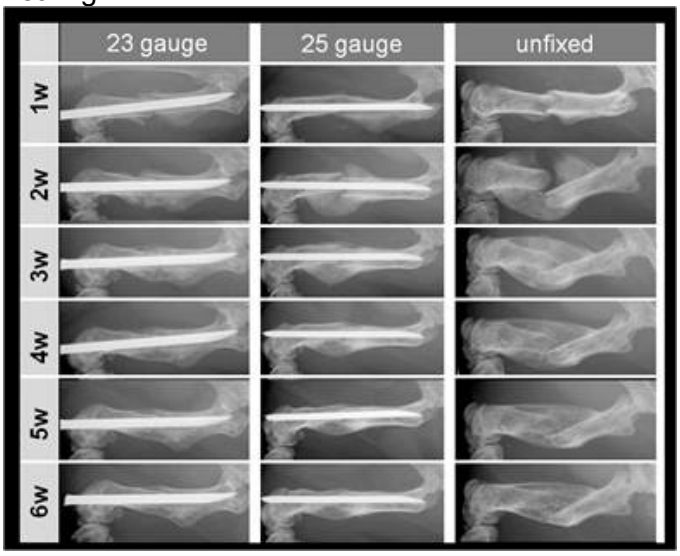
SUMMARY: Fixation stability in the murine fracture model affects fracture vascularity required for proper healing.

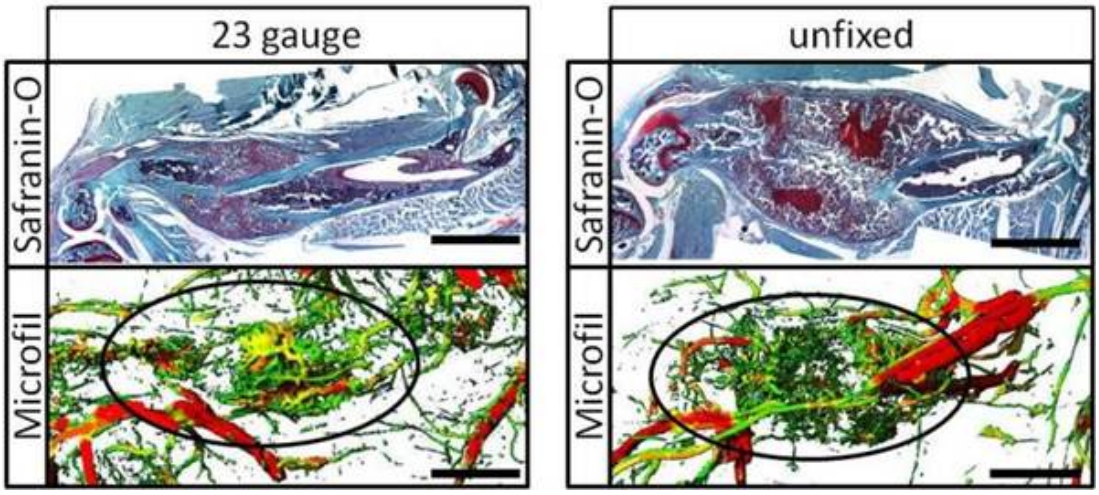
INTRODUCTION: Implant rigidity is known to affect fracture callus size and healing rates. We hypothesized that this was due to, in part, the effect on neo-vascularization of the healing fracture. We tested this hypothesis in a murine model of fracture healing.

METHODS: Midshaft femoral fractures were performed in eight week C57BL/6 mice using a 23 gauge pin (23G, diameter of pin: 0.6414 mm, n=20) and a 25 gauge pin (25G, diameter of pin: 0.5144 mm, n=11) for fixation and no pin for unfixed fractures (n=10). Radiographs were taken every week for six weeks and callus diameter (mm) and area (mm^2) was determined at two and six weeks. Vascular supply of the healing fracture was determined by perfusing Microfil, a radio-opaque silicone rubber containing lead chromate, via cardiac puncture and analyzed with μCT. Histological analysis was performed using Safranin-O staining to evaluate the avascular cartilage area and CD31 immunohistochemical staining to confirm the presence of blood vessels at the fracture site.

RESULTS: Weekly radiographs demonstrated that the unfixed group (no pin) had a statistically larger callus diameter and area by three weeks post fracture compared to fixed groups (23G and 25G) and that the 25G pin created callus sizes statistically larger than 23G pin. At two weeks post fracture, avascular cartilage was detected in the unfixed group that was absent in the fixed groups which corresponded to the extent of vascularity determined by Microfil and confirmed by CD31 staining. Therefore, the unfixed fractures achieved the greatest callus size but failed to remodel even after six weeks post fracture compared to fixed fractures.

CONCLUSION: These findings demonstrate that less rigid fracture fixation leads to more vascularization at the fracture site, but delays remodeling and therefore proper healing. These findings suggest that the balance of the fixation is critical for fracture remodeling and healing and may potentially allow for manipulation of vascularity at the fracture site to improve fracture healing.




23 gauge
unfixed
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Microfil

201. Validation of the Dual-Purpose Musculoskeletal Review of Systems (msROS) Questionnaire

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INTRODUCTION: Rapid cost-effective comparison of outcomes of patients with musculoskeletal problems requires practical self-reported questionnaires with good psychometric properties. We aimed at validating a brief dual-purpose (clinical process and clinical research) questionnaire, the musculoskeletal review of systems (msROS).

METHODS: MsROS, PSS, KOOS, and HOOS data on approximately 90,000 consecutive encounters were extracted from the OrthoMiDaS database and classified. For instrument validation, we used several cross-sectional (floor and ceiling effect, convergent, divergent, and discriminate validity) and longitudinal (test-retest reliability and responsiveness) cohorts.

RESULTS: Among three groups of patients the floor and ceiling effects were in the range from 1.3% to 8.5%. Convergent, divergent, and discriminant validity were tested by studying multivariate relationships between the msROS, PSS, KOOS, and HOOS. All models were significant at $p<0.00001$. Coefficients expected to be high were found to be high; coefficients expected to be low were found to be low and non-significant. The msROS demonstrated good test-retest reliability – the intra-class correlation was greater than 0.7 for three different time intervals. Sensitivity-to-change was tested in three groups of patients who underwent primary joint arthroplasty for osteoarthritis. The msROS's sensitivity-to-change is better than that of the SF12 and worse than that of corresponding joint-specific questionnaires in all three groups of patients.

CONCLUSION: The study demonstrates that the msROS self-reported instrument initially developed as a patient-reported component of the clinical process, has good psychometric properties. As a result, it can be recommended as an instrument of choice for large-scale clinical trials and observational studies with long follow-up.

202. Tranexamic Acid in Orthopedic Oncology: Safety and Efficacy

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The antifibrinolytic effect of tranexamic acid (TXA) has been reported to reduce blood loss in total joint and spinal procedures; however, the impact on hemostasis has not been reported in orthopedic oncology. This study evaluates the safety and efficacy of TXA in patients undergoing oncologic resections in procedures with significant anticipated blood loss. The study group consists of 48 patients treated perioperatively with TXA. The procedures included 21 distal femur replacements, 18 proximal femur replacements, and 9 soft tissue sarcomas (>20 cm in diameter). Pathology included 18 patients with metastatic disease, 9 osteosarcoma, 4 Ewing sarcoma, 2 chondrosarcoma, 9 high grade soft tissue sarcomas, 2 myeloma, 2 lymphoma of bone, 1 angiosarcoma of bone, and 1 leiomyosarcoma of bone. Each patient was administered 1 gram of intravenous TXA 10 minutes prior to surgical incision, 1 gram at the beginning of closing, and 1 gram 3 hours postoperatively. A patient matched historical control group of 56 patients treated by the same surgeon during a period that TXA was not used was used for comparison. The study evaluates intraoperative blood loss, postoperative complications, incidence of transfusion, and hospital stay of the study group compared to the control group. We analyzed group differences in the study demographic and operative parameters using one-way ANOVA; analyses were performed using Stata1 8.2 software. Infection incidence, thromboembolic events, and cardiac related problems were not significantly different between the study and control groups (p=0.20, 0.07, 0.15, respectively). Blood loss, incidence blood transfusion, and hospital stay were all reduced with statistical significance (p value =.010, .033, and 0.044, respectively). Hospital stay for the controlled averaged 6.3 days, and the study group averaged 4.1 days. Postoperative blood loss, as determined by drain output, was also significantly reduced (average 420 cc vs. 714 cc). Tranexamic acid appears to be safe and effective in reducing blood orthopedic oncologic procedures. Randomized, prospective studies are needed to further validate this study's findings.

203. Platelet-Rich Plasma vs. Kenalog: An In Vitro Comparison of Gene Expression Changes in Osteoarthritic Human Chondrocytes♦

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Jeffrey C. Flynn, Ph.D.	Detroit, MI
David C. Markel, M.D.	Southfield, MI

BACKGROUND: The hallmark pathophysiological change of osteoarthritis (OA) is inflammation, which tips the balance of catabolism and anabolism, leading to extra-cellular matrix (ECM) breakdown and cartilage degeneration. Standard of care for acute treatment of the painful osteoarthritic joint is injection with corticosteroid agents such as Kenalog. Recent studies suggest favorable results from intra-articular Platelet-Rich Plasma (PRP) knee injections for treatment of degenerative cartilage lesions. Studies are currently underway comparing the efficacy of intra-articular PRP with traditional cortisone and hyaluronic acid therapies.

PURPOSE: To develop an in vitro model of cartilage degeneration with human chondrocytes treated with interleukin-1B (IL-1B) (10 ng/mL) to compare the effect of PRP and Kenalog therapies on chondrocyte gene expression, and to assess for potential toxicity of these treatments.

METHODS: Platelet-Rich Plasma Releasate (PRPr) was prepared using blood from three human donors; platelet degranulation was induced using 10% CaCl2. Using our OA model, we compared anabolic and catabolic gene expression changes in human osteoarthritic chondrocytes secondary to treatment with PRPr (1% and 10%) vs. Kenalog (1% and 10%). Polymerase chain reaction was used to quantify mRNA gene expression changes for Aggrecan, Col-1A (Type I Collagen), Col-2A (Type II Collagen), MMP13 (Matrix Metalloproteinase 13), ADAMTS4 (Aggrecanase with Disintegrin and Metalloproteinase with Thrombospondin Motifs 4), ADAMTS5 (Aggrecanase with Disintegrin and Metalloproteinase with Thrombospondin Motifs 5), and BMP-2 (Bone Morphogenic Protein 2). Biostatistical analysis was performed using ANOVA with Tukey HSD post-hoc test. Flow cytometery was used to assess cell viability.

RESULTS: In human osteoarthritic chondrocytes, Kenalog 10% significantly upregulated the expression of Aggrecan as compared to PRPr 10% ($p=0.046$). Similar upregulation in response to Kenalog 10% vs. PRPr 10% was seen with Col2A ($p= 0.002$). Conversely, MMP-13 expression was increased significantly with PRPr 1% vs. OA control chondrocytes ($p=0.05$). Finally, BMP-2 expression increased significantly with PRPr 1% vs. Kenalog 1% ($p=0.014$), and PRPr 1% vs. Kenalog 10% ($p=0.02$).

DISCUSSION: Aggrecan and Type II Collagen (Col-2A) are composite building blocks of cartilage ECM, whose gene expression has an anabolic effect. BMP-2 is thought to play an anabolic role by contributing to the intrinsic repair capacity of damaged cartilage. MMP-13 is known to have catabolic effects on the extracellular collagen matrix of human chondrocytes. Thus, our preliminary in vitro data would suggest that the gold standard treatment with Kenalog promotes ECM anabolism. PRPr has a mixed effect, with both anabolic (increased BMP-2 expression) and catabolic (increased MMP-13 expression) gene changes.

CONCLUSION: In vitro human OA chondrocytes treated with kenalog upregulate the expression of Aggrecan and Col2A promoting an overall anabolic ECM; whereas, PRPr treatment results both catabolic (MMP-13) and anabolic (BMP-2) effects. As the balance of anabolism and catabolism with PRPr is yet to be determined, intra-articular injections of PRP should be used with caution.

204. Acute Effects of Local Anesthetics on Human Chondrocytes In Vitro in an Alginate Bead Model

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BACKGROUND: A number of recent studies have examined the effects of various local anesthetics on articular cartilage in vitro as well as in animal models. The toxic effects of these compounds are well documented. Animal models have demonstrated cellular and metabolic changes after even a single injection. However, their use remains common in clinical practice.

PURPOSE: This study examines the effects of various concentrations of lidocaine, bupivacaine, and ropivacaine on chondrocytes in alginate bead culture. Alginate bead culture was chosen to simulate the in vivo environment and avoid complications such as dedifferentiation when these cells are grown in monolayer.

METHODS: Discarded tissue from six total knee arthroplasty patients was collected with IRB approval. Cells from different donors were not mixed. The beads were exposed for one hour to lidocaine, bupivacaine, or ropivacaine mixed 1:1 with culture media. Beads were then dissolved and cells harvested for RNA isolation or toxicity assessment. Outcome measures include: cell death measured by flow cytometry as well as mRNA for GAPDH, MMP-13, aggrecan, and collagen-2A1.

RESULTS: 1% lidocaine was significantly more toxic than normal saline controls. Bupivacaine demonstrated dose-dependent toxicity at various concentrations versus controls. No statistically significant differences were evident in the ropivacaine groups. The highest concentrations of lidocaine and bupivacaine had such harmful effects that sufficient mRNA could not be isolated from these groups. Expression of type II collagen mRNA was found to be decreased versus control in two of the bupivacaine groups. Elevated MMP-13 levels were found in the highest bupivacaine concentration for which sufficient mRNA was isolated for testing.

CONCLUSION: Toxicity was demonstrated for lidocaine and bupivacaine versus controls, and dose-dependent cytotoxic effects were demonstrated for bupivacaine. This study may serve as a foundation for further work to allow for observation of changes in cellular metabolism and gene expression resulting from exposure to these compounds.

205. Inhibition of Asporin Signaling is Critical in Preventing Cartilage Damage by Exercise

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Jin Nam, Ph.D.	Riverside, CA
David C. Flanigan, M.D.	Columbus, OH
Sudha Agarwal, Ph.D.	Columbus, OH

INTRODUCTION: Exercise represents a non-invasive treatment option for arthritic diseases. Here, we examined the signaling pathways responsible for the beneficial effects of exercise on various stages of monoiodoacetate-induced arthritis (MIA). Asporin, a susceptibility gene in osteoarthritis (OA), has been suggested to mediate matrix synthesis through Transforming Growth Factor-β (TGF-β) networks essential for cartilage matrix synthesis.

METHODS: Treadmill walking (TW) was used to expose MIA afflicted knees to physiotherapy, initiated in rats at different stages of MIA and compared to unexercised MIA afflicted knees. Specimens were analyzed by macroscopic, microscopic, μCT imaging, transcriptome-wide gene expression analysis, and Ingenuity Pathways Analysis to construct molecular functional networks and signaling pathways.

RESULTS: TW 1 day post-MIA induction significantly prevented MIA progression. However, the efficacy of exercise was reduced when implemented on knees with Grade 1 or greater cartilage damage. In contrast, TW accelerated damage in the knees with close to Grade 2 pathologies. Gene expression analysis revealed exercise intervention started on Grade 1 cartilage significantly suppressed signaling networks that inhibit matrix synthesis and up-regulated gene networks associated with matrix synthesis; however, less benefit was seen when exercise was implemented on knees with greater damage. Asporin and networks associated with TGF-β expression were the major gene products regulated by exercise to control matrix synthesis and prevent cartilage damage as evident by microscopic grading and gene analysis.

DISCUSSION: The extent of cartilage damage at the initiation of exercise is an important determinant of the effectiveness of exercise, being most effective when implemented on knees with Grade 1 or lesser damage compared to knees with Grade 2 or greater damage. Asporin plays a significant role in mediating the effects of exercise. Its suppression during early exercise is paralleled by matrix synthesis likely via TGF-β activation, while its expression during later stages of OA may be responsible for the failure of cartilage to heal itself.

206. Developing, Optimizing, and Validating Genipin Sterilization of Bone Allografts

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Rodrigo Iglesias, M.S.	Cleveland, OH
Ozan Akkus, Ph.D.	Cleveland, OH

INTRODUCTION: Gamma radiation sterilization of bone allografts minimizes disease transmission, but impairs strength. Genipin crosslinking may safely sterilize allografts without detrimental biomechanical consequences.

METHODS: Genipin's sterilization potential was established by treating Bacillus subtilis var. niger, B. pumilus, and Geobacillus stearothermophilus spore strips with 0.63-10% genipin (2.6-42 mg/10^6 spores) in phosphate-buffered saline (PBS) or 1:1 dimethyl sulfoxide (DMSO): PBS for 72 hours at room temperature (RT). Scanning electron microscopy (SEM) evaluated spore morphological changes secondary to genipin treatment for insight into genipin's sporicidal mechanism. Effects of temperature (RT, 37˚C, or 50˚C), DMSO: PBS ratio (0: 100 to 100: 0), and treatment duration (24, 48, or 72 hours) were assessed. Tissue penetration and sterilization was studied by treating B. subtilis spores isolated between slices of bovine femoral cortex for 48 hours and 1 week. Three-point bending tests were performed on bovine femoral diaphyseal cortical beams treated with 0.63% or 6.0% genipin in PBS, 1:1 DMSO: PBS, or 90% ethanol for 1 week at 37˚C. MC3T3 pre-osteoblasts were seeded onto genipin-sterilized bovine bone specimens to evaluate cytotoxicity.

RESULTS: All doses and concentrations of genipin/DMSO: PBS sterilized B. subtilis, B. pumilus, and G. stearothermophilus spore strips after 72 hours at RT. SEM showed no gross morphological spore changes. Sporicidal efficacy was time- and temperature-dependent and was facilitated by DMSO. Genipin penetrated bone retaining sporicidal activity; treatment led to dose-dependent increases in yield strain and resilience. Cell proliferation was noted on genipin-sterilized bones.

CONCLUSIONS: Genipin has broad-spectrum sporicidal activity which we hypothesize is due to crosslinking intracellular protein and DNA. Genipin penetrates and sterilizes bone, improves yield mechanics, and is osteoconductive. Genipin treatment appears to be a viable alternative for sterilizing bone allografts while maintaining mechanical integrity.

207. Pre-Referral MRI Use in Musculoskeletal Oncology Patients is Not Excessive

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*Benjamin J. Miller, M.D.	Iowa City, IA

OBJECTIVE: Health care spending in the United States has increased substantially in recent years, and expenses related to the use of Magnetic Resonance Imaging (MRI) have been targeted as a particular area of concern. However, little data exists with regards to inappropriate MRI use in musculoskeletal oncology patients. In this study, our objective was to identify the cost and incidence of the unnecessary and repeated MRI imaging studies amongst our musculoskeletal oncology patients who arrived with an MRI completed prior to their referral.

METHODS: We retrospectively reviewed 920 musculoskeletal tumor patients from 2009 to 2010 to identify patients who either arrived with an unnecessary MRI or who had a repeat of their pre-referral MRI. We accepted as necessary any MRI for a primary bone sarcoma, for biopsy-proven soft tissue sarcomas, for soft tissue masses greater than 5 cm in diameter, for soft tissue masses deep to the fascia, for painful soft tissue masses, and for soft tissue masses that reportedly had been growing. Patients without these specific criteria were reviewed by a team of musculoskeletal oncologists to determine the necessity. The criteria for a repeat MRI were failure to visualize the tumor, lack of gadolinium contrast, lack of T1 or T2 MRI sequence, or poor image quality. Cost was determined using 2010 Medicare reimbursement rates.

RESULTS: Of 920 patients, 320 (35%) arrived with an MRI completed before referral. Eight of the 320 (3%) studies were unnecessary for making the diagnosis or for surgical planning, and 12 (4%) were necessary, but were repeated. The total cost of these 20 inappropriate studies was $11,474, which averages to $574 per study and $36 of waste per patient referred with an MRI.

CONCLUSIONS: MRI use by physicians in the community prior to referral to our tertiary center was not excessive. This is likely due, in part, to the relatively low utilization of MRI in our referral base. Overall, our results indicate that inappropriate MRI use in oncology patients may not be as widespread as previously reported.

208. Symptomatic Deep Venous Thrombosis Following Soft Tissue Mass Resections

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Martha George, M.D. Birmingham, AL
Jonathan K. Jennings, M.D. Birmingham, AL

The incidence of deep venous thrombosis following soft tissue tumor surgery has not been well studied. A protocol for prophylaxis is not universally accepted. The identification and importance of potential risk factors is also poorly defined. The goal of this study is to report the incidence and potential risk factors for patients with symptomatic deep venous thrombosis (DVT) following soft tissue surgery. A retrospective review of patients treated at a single institution was conducted between 2002 and 2008. 421 patients were identified and medical records reviewed to identify the incidence of thrombosis and potential risk factors. An incidence of symptomatic deep venous thrombosis was noted in less than 2% (n=7) of patients. Five patients had high grade sarcomas that were pretreated with radiation, one patient a benign schwannoma and one with a low grade liposarcoma. Weight, age, and postoperative activity level were not found to be independent risk factors. 105 of the 410 patients received chemoprophylaxis and 316 did not. No statistically significant difference in the incidence of symptomatic thrombosis was seen between those treated with chemoprophylaxis and those that were not. Of the 7 patients with DVT, 4 received chemoprophylaxis with Lovenox™ and 1 with aspirin and 2 without prophylaxis. Tumor size greater than 10 cm and a history of thrombosis were noted in 5 of 7 patients. A higher wound complication incidence was seen in the group of patients receiving chemoprophylaxis compared to those that did not (11 vs. 5). Three of 410 had postoperative pulmonary thrombosis documented by CT angiography. Two of the three patients were on chemoprophylaxis at the time of the event. Chemoprophylaxis may be used following the treatment of soft tissue tumors; however, it should be prescribed at the surgeon's discretion. There is no conclusive evidence that chemoprophylaxis is of benefit in soft tissue tumors, however, may be considered in patients with tumors greater than 10 cm and/or with a history of thrombosis. There does appear to be a higher incidence of wound complications with the use of Lovenox™.

209. Successful Prosthetic Rehabilitation Following Hip Disarticulation or Hemipelvectomy: The Mayo Clinic Experience

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Matthew T. Houdek, M.D.	Rochester, MN
Courtney E. Sherman, M.D.	Rochester, MN
Thomas C. Shives, M.D.	Rochester, MN
*Peter S. Rose, M.D.	Rochester, MN
Franklin H. Sim, M.D.	Rochester, MN

OBJECTIVE: Prosthetic rehabilitation following hemipelvectomy and hip disarticulation surgeries has been considered by some to be a non-viable option. Subsequently, many patients are never fit with a prosthesis. The objective of the study was to evaluate the characteristics of successful prosthetic users, to determine what factors are predictive of successful prosthetic use, and to evaluate the functional impact of prosthetic use.

METHODS: We reviewed our surgical database for patients who underwent hip disarticulation or hemipelvectomy between 2000 and 2010, lived at least six months after surgery, and had follow up at our institution. Forty-three patients were identified that met these criteria. We investigated patient demographics, characteristics hypothesized to predict unsuccessful prosthetic rehabilitation, and the usage profile of successful users.

RESULTS: 43% (n=18) of patients successfully used a prosthesis. The most common reason that a patient did not use a prosthesis was that they were not offered one. The only pre-operative factor that predicted unsuccessful prosthetic use was coronary artery disease. None of the characteristics investigated excluded a patient from being a successful prosthetic candidate, including advanced age, morbid obesity, depression, and arthritis. Successful prosthetic users ranged in age from 16-74 years old, and BMI from 18.4-36.1. They enjoyed long survival times with 89% alive at 60 months and 69% at 120 months. They wore their prosthesis for an average of 5.8 hours per day, and ambulated an average of 158 feet without resting. Most used a gait aid, with 50% able to ambulate with one or both hands free.

CONCLUSIONS: Successful prosthetic rehabilitation following hemipelvectomy and hip disarticulation is possible. High BMI, advanced age, depression, and other co-morbidities should not discourage prosthetic rehabilitation. Most patients that undergo successful prosthetic rehabilitation enjoy long periods of survival, wear their prosthesis for most of the day, and enjoy increased independence, functional mobility, and aesthetic restoration.

210. Dynamic In Vivo Elbow Kinematics: Techniques and Preliminary Findings

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INTRODUCTION: A comprehensive understanding of elbow mechanics is important in the study of pathologic conditions and associated surgical reconstructions. Unfortunately, the mechanics of the elbow under in vivo conditions remains poorly understood. The objectives of this study were to characterize the accuracy of a model-based tracking technique and demonstrate its in vivo application for quantifying elbow mechanics.

METHODS: The accuracy of model-based tracking for quantifying elbow kinematics was determined in an in vitro experiment. Biplane x-ray images of a cadaveric elbow were acquired as it was manually moved through flexion-extension. The 3D position and orientation of each bone was determined using a non-invasive model-based tracking technique. For comparison, the position and orientation of each bone was also determined by tracking the position of implanted beads with dynamic radiostereometric analysis. In vivo motion of four subjects was also collected. Elbow motion was reported using screw displacement axes. Joint contact patterns were estimated using interbone distances and proximity maps.

RESULTS: The in vitro validation demonstrated that model-based tracking is accurate to within ±1 mm and ±1° for measuring elbow motion. For the in vivo application, the average screw displacement axis of each subject throughout the entire range of motion was close to the anatomical flexion-extension axis. At the ulnohumeral joint, minimum interbone distance was on the medial facet of the trochlea. At the radiohumeral joint, minimum interbone distance shifted medially with elbow extension.

DISCUSSION AND CONCLUSION: Model-based tracking is an accurate technique for measuring in vivo, 3D, dynamic elbow motion. Preliminary data acquired are in agreement with previous studies. It is anticipated that this experimental approach will enhance our understanding of elbow mechanics as it can be used to study the extent to which mechanics are altered following disease, injury, or surgery. Evaluation is currently underway exploring changes in valgus elbow stresses and joint contact patterns as a result of UCL injury and reconstruction.

MAOA BREAKOUT SESSION #15
Foot and Ankle
April 20, 2013

211. Progressive Foot Deformity Evident in Neuropathic Charcot Arthroplasty at One and Two Years

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Charles F. Hildebolt, Ph.D.	St. Louis, MO
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Fred W. Prior, Ph.D.	St. Louis, MO
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INTRODUCTION: Foot deformity associated with neuropathic Charcot arthropathy (NCA) contributes to joint instability, ulceration, and amputation. The purpose of this study was to follow patients with and without acute NCA for up to two years to examine the magnitude and timing of foot alignment changes.

RESULTS: Meary's angle, cuboid height, and calcaneal pitch were worse in NCA involved feet at baseline ($p<.05$), one year ($p><.05$), and two years ($p><.02$) compared with the NCA uninvolved and DMPN feet. Baseline Meary's angle and cuboid height were worse in NCA involved feet compared to unimpaired comparison feet ($p><.01$), and Meary's angle was worse in NCA uninvolved feet compared to unimpaired comparison feet ($p=.03$). NCA involved feet alignment worsened over year one as measured by Meary's angle ($p><.01$), cuboid height ($p><.01$), and calcaneal pitch ($p><.01$), and cuboid alignment continued to worsen over year two ($p=.01$). The NCA involved feet, with six-month interval data during year one, had worsening of Meary's angle during the first six months ($p=.03$) and remained stable for the remaining follow-up period. The change in hindfoot-forefoot angle over one year was worse in the NCA involved feet compared to the NCA uninvolved ($p=.02$) and DMPN feet ($p=.01$).

CONCLUSION: Radiographic alignment measures demonstrate baseline foot deformity with progressive changes ("creep") over the first and second year. Six-month interval data suggest worsening of alignment of the medial column prior to the lateral column. Repeat alignment measures provide useful information about foot alignment stability and changes our traditional understanding of the natural history of NCA. Radiographic evidence of worsening foot alignment indicates the need for aggressive intervention (conservative bracing or surgical fixation) to prevent limb threatening complications from severe deformity and joint instability.

212. Complications After Popliteal Block for Foot and Ankle Surgery

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INTRODUCTION: Peripheral blockade of the sciatic nerve in the popliteal fossa is a commonly employed form of analgesia for foot and ankle procedures. A very low (0.5-1%) occurrence of neuropathic symptoms and complications is reported after this block. This study reports the incidence of neuropathic manifestations and other complications in 220 patients who received a popliteal block for foot and ankle surgery.

METHODS: CPT codes were used to identify patients who received a popliteal block for foot and ankle surgery beginning March 2009 through August 2009 and a retrospective review of their perioperative, anesthesia, and follow-up records was conducted. The primary outcome variable was the incidence of neuropathic symptoms. Probable risk factors were identified and the significance of each factor towards the primary outcome variable was assessed by Chi square and T tests. Patient data was accessed minimum follow-up of four months.

RESULTS: 220 patients were included in this study out of which 170 patients received a single shot block while 50 received a continuous catheter infusion. The mean age of the patients was 50.6 years (range 13-85). Nine of 50 patients with continuous catheter (18%) and 23 of 170 patients with a single shot block (13.5%) reported neuropathic symptoms in the postoperative period. In three patients, the symptoms were severe enough to warrant referral to a pain clinic. Univariate statistics did not show smoking ($p=0.26$), prior diabetes ($p=0.39$), tourniquet location ($p=0.26$), type of block ($p=0.83$), guidance used ($p>0.999$), or use of epinephrine ($p=0.09$) to be significantly associated with neuropathic symptoms. Similarly, tourniquet pressure ($p=0.58$), tourniquet time ($p=0.98$), and BMI ($p=0.58$) were also not significantly associated with neuropathy. One patient had a generalized seizure after ropivacaine injection, but recovered without any permanent deficit.

CONCLUSION: Neuropathic adverse events have a much higher incidence following popliteal block than has been reported in the literature. A prospective analysis would be beneficial to determine the true incidence of these symptoms and associated risk factors.

213. What Affects Nonunion After Intramedullary Nailing for Distal Tibial Fractures?

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INTRODUCTION: The purpose of this study was to elucidate postoperative radiographic alignment and factors associated with nonunion (NU) after intramedullary nailing (IMN) for distal tibia fractures.

METHODS: From 2002 to 2010, 250 consecutive patients distal tibia fractures (<11 cm from the joint line, OTA 43) treated with IMN were retrospectively evaluated. Patients were followed in a single large private orthopedic practice affiliated with a Level I trauma center. Excluded patients were related to initial arthrodesis (1), amputation (2), and follow-up less than ten months (123) or insufficient data (48). Therefore, the final study group consisted of 76 distal tibia fractures.

RESULTS: There were 41 male (54%) and 35 female patients (46%) with a mean age of 39 years (18-81) and an average body mass index (BMI) of 27.8 kg/m². Mean follow-up was 24.6 months (10-70). The majority of the injuries were caused by high energy trauma 46 (59%) with 25 (33%) open fractures. The average distance to the joint line was 6.7 cm (1.5-11). An accompanying fibula fracture was diagnosed in 68 (89%) and treated in 26 patients with plating (20) or rush pin (6). Hardware removal was performed in 32 patients (19 nails, 12 screws, 1 rush pin). Wound complications occurred in 10 patients (13%). Radiographic evaluation showed a mean AP angulation of 2.5° valgus with 4 patients having > 5° varus and 17 patients > 5° valgus. The joint line in the lateral view averaged 88.8°. NU occurred in 12 patients (15.4%). The nail was proximally fixed with one screw in 53 (70%) and distally with two screws in 64 (84%). In 20 patients, the distal nail fixation included an anterior-posterior oriented nail of which 3 resulted in NU. Additional screw (22) and plate (5) fixation of the distal tibia was performed in 27 patients (36%). The NU rate was significantly higher (p=0.02) with repaired (7) or intact (2) fibular, than without fixation. The rate of wound complications 5 (42%) in NU was significantly higher (p=0.006), than in unions 5 (8%).

CONCLUSION: IMN is an appropriate treatment option for distal tibia fracture. Fixation with one screw proximal and two screws distal is sufficient. The rate of NUs was significantly higher with an intact fibula or operative fixation of the fibula.

214. Comparing Different Surgical Techniques for Addressing the Posterior Malleolus in Supination External Rotation (SER) IV Ankle Fractures and the Need for Syndesmotic Screw Fixation

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BACKGROUND: Recent literature has focused on the role of the posterior malleolar fracture on syndesmosis stability. The primary purpose of this study is to determine if fixation of the posterior malleolus in SER IV ankle fractures would decrease the need for syndesmotic screw fixation.

METHODS: A retrospective chart review was performed on all adult patients with trimalleolar or trimalleolar equivalent ankle fractures treated by two attending surgeons (TVL, ML) between October of 2006 and April of 2011. Preoperative standard three-view ankle x-rays and CT scans of the ankle were evaluated to confirm the diagnosis of trimalleolar fractures and to classify the pattern in regards to the Lauge-Hansen. Operative notes and intraoperative fluoroscopic stress views were reviewed to evaluate ankle stability. Finally, postoperative radiographs were evaluated for fixation patterns.

RESULTS: A total of 143 trimalleolar or trimalleolar equivalent ankle fractures were evaluated for the study. Of these, 97 patients (average age 44 [range, 19-85]) sustained fractures classified as SER IV (69%) type injuries. Seventy-four of the 97 patients (76%) with SER IV patients had sizable posterior malleolus fragment for fixation. Thirty-four received posterior malleolar fixation and 40 did not. Among the 34 SER IV with posterior malleolar fixation, only 7 (20.6%) required additional syndesmotic fixation while when the posterior malleolar fragment was not fixed, 27/40 (68%) required syndesmotic fixation (P=0.0002). 15/34 posterior malleolar fixation was performed with indirect reduction using an anterior to posterior screw. 19/34 was performed with direct reduction using posterior plate fixation. 7/15 (anterior-posterior screw fixation) still required syndesmotic stabilization (46.7%). 0/19 (plate fixation) required syndesmotic stabilization (P=0.0012).

CONCLUSION: Fixation of the posterior malleolus fracture in SER IV ankle fractures could restore syndesmotic stability and, thus, lower the rate of trans-syndesmotic fixation. Subsequently, this would eliminate the need for transyndesmotic screw removal.

215. Diagnosing Chronic Diastasis of the Syndesmosis – A Novel Measurement Using Computed Tomography

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BACKGROUND: Chronic diastasis of the syndesmosis is increasingly being recognized as a cause of post-traumatic ankle pain and dysfunction. Recent studies have sought to define imaging criteria to aid in the diagnosis of syndesmotic diastasis, but no consensus exists. In this series, we evaluated the use of bilateral preoperative CT scans to identify new radiographic parameters that may aid in the diagnosis of chronic syndesmotic diastasis. To our knowledge, the measurements presented here have not previously been reported in symptomatic patients.

METHODS: Twelve patients with a prior rotational ankle injury and physical examination findings consistent with syndesmotic diastasis received a bilateral preoperative CT scan. Two measurements were performed: first was the angle subtended by the two tangents to the tibia and fibula 1 cm above the tibial articular surface; second was the area bounded by the lateral tibia, medial fibula, and the two tangent lines used for the angular measurement. Statistical analysis with paired t-tests at a significance of $p \leq 0.05$ was performed on the data.

RESULTS: When comparing the injured and uninjured ankle, we found a significantly smaller angular measurement of 63.2 +/- 5.7 degrees vs. 68.5 +/-7.0 degrees (p-value 0.032) and a significantly larger area measurement, 1.56 +/- 0.3 cm^2 vs. 1.13 +/- 0.22 cm^2 (p-value 0.00003). All patients were confirmed to have syndesmotic diastasis based on manual testing performed at the time of their reconstructive surgery.

DISCUSSION AND CONCLUSION: Based on axial CT scans, we describe a novel technique, using an angular measurement as well as a measure of area, that could aid in the evaluation of syndesmotic diastasis after a rotational ankle injury. This appears to be a straightforward technique and has the advantage of not relying on conventional anatomic landmarks that are frequently distorted after ankle trauma. In this small cohort of patients, the measurements appeared to be reliable and reproducible.

216. Are Hook Plates Advantageous Compared to Antiglide Plates for Vertical Shear Malleolar Fractures?

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OBJECTIVES: The purpose of this project is to evaluate the biomechanical properties of the hook plate versus the antiglide plate in the treatment of the supination-adduction (SAD) ankle fracture.

METHODS: Fourth generation polyurethane models of the left tibia were obtained. Each model was subjected to pre-testing stiffness. Identical vertical fractures were created on all specimens. The fractures were then fixed with one of the following: a 5-hole one third tubular plate in an antiglide fashion with two screws proximal to the fracture (TwS), the same anti-glide plate with an additional screw perpendicular to the vertical shear fragment (ThS), or a hook plate (HP). Ten models were randomly assigned in each of the three groups. The constructs were then tested offset axial loading to simulate loading in supination. The various constructs were evaluated for construct stiffness and load to failure, defined as 2 mm of displacement of the fracture, or overall catastrophic failure. ANOVA analysis with post hoc Tukey HSD analysis was performed on the data.

RESULTS: Pre-test stiffness was not significantly different among models. The ThS yielded significantly higher plate stiffness versus the TwS ($p<0.05$) and the HP ($p<0.05$). The difference of plate stiffness of the HP construct compared to the TwS was not significant ($p=.350$). When analyzing load to failure the ThS, TwS, and HP constructs failed on average at 754N, 116N, and 223N, respectively. The differences between the ThS and TwS, and ThS and HP was 638N and 530N respectively ($p<0.05$). The HP had a load to failure that was on average 108N more than the TwS, but this was not significant ($p=.063$).

CONCLUSION: These results suggest that the use of a one third tubular plate with two screws proximal and one additional perpendicular to the fracture provides a stable, strong construct for fixation of vertical shear medial malleolus fractures. Our study included biomechanical testing of a HP. The HP offered ease of application, however, did not provide a significantly stiffer or stronger construct than the traditional antiglide plating technique.

217. A Retrospective Comparison of Total Ankle Arthroplasty vs. Arthroscopically Assisted Ankle Fusion for End Stage Ankle Arthritis

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INTRODUCTION: The use of noncemented anatomic total ankle prostheses is gaining widespread use in the United States. However, ankle fusion remains the gold standard procedure for end stage ankle arthritis. The goal of our study was to perform a retrospective evaluation of the safety and efficacy of a noncemented prosthesis to treat end stage ankle arthritis and compare the outcomes to arthroscopically assisted ankle fusion.

METHOD: Patients undergoing total ankle arthroplasty or arthroscopically assisted ankle fusions were asked to fill out AOFAS, SF-36, and VAS both preoperatively and postoperatively. They all underwent a full radiographic assessment with AP, lateral, dorsiflexion, and plantarflexion views of the operative ankle at least six months after surgery. These radiographs were assessed for adjacent joint changes and measurements of component placement, dorsiflexion, and plantarflexion. Charts were reviewed to obtain any postoperative complications. The improvement in either group in SF-36, AOFAS, and VAS scores was analyzed using a one-tailed Student t test. Differences between the two groups were analyzed using a two-tailed paired Student's t test.

RESULTS: In total, there were 14 fusions and 32 total ankle replacements who had full sets of data. In the total ankle group, there were two reported complications. In the fusion group, there was one nonunion. The average time of follow-up was 17 months for the total ankle group and 30.5 months for the ankle fusion group. In both groups, there was a statistically significant improvement in the physical component of the SF-36 score, AOFAS, and VAS score ($P<0.05$). The changes in the mental component of the SF-36 were not statistically significant in either group. There was not a significant difference in outcomes between the groups.

CONCLUSION: Although our study is limited due to the small sample size, we found that total ankle arthroplasty performed comparably to arthroscopically-assisted ankle fusions in patients of similar ages with end stage arthritis suggesting that total ankle arthroplasty is a safe and effective alternative to ankle fusion in patients with end stage arthritis.

218. Trends in the Use of Total Ankle Replacement and Ankle Arthrodesis in the United States Medicare Population

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BACKGROUND: Total ankle arthroplasty (TAA) has gained acceptance as an alternative to traditional ankle arthrodesis (AA) for end stage ankle arthritis. Little is known about long-term national trends in volume, utilization, and patient characteristics. The objective of this study is to use longitudinal data to examine temporal trends in TAA and AA.

METHODS: We identified all fee-for-service Medicare beneficiaries who underwent TAA and AA between 1991 and 2008 (N=4,292 and 26,286 respectively). We examined changes in volume, volume and per capita utilization, length of stay (LOS), and 30-day readmission rates.

RESULTS: Between 1991-2008, annual TAA volume increased 740% from 72 procedures/year to 533 while per-capita utilization increased 614% ($p<0.001$). AA volume increased 42% from 1,167 procedures/year to 1,655 while utilization increased 18% ($p<0.001$). LOS decreased dramatically from 8.7 days in 1991 to 2.4 days in 2008 in TAA and from 5.5 days to 2.7 days in AA ($p<0.001$). For both procedures, average 30-day readmission rates over the same time interval were similar at 4.8% for TAA and 4.7% for AA ($p=0.16$). Although patients undergoing TAA were consistently older than AA (73.0 vs. 72.5 years), average patient age for TAA decreased slightly while the average age of those obtaining AA increased ($p<0.001$).

CONCLUSIONS: Both TAA and AA volume and utilization increased between 1991 and 2008. For TAA, however, the rate of volume and utilization change outpaced that of AA. Thirty-day readmission rates remained comparable between TAA and AA. Patients undergoing TAA were typically older than those receiving AA. Overall, wider acceptance of TAA use is seen in the United States Medicare population over 1991-2008.

219. Clinical Outcome of Tibiotalocalcaneal Arthrodesis with Lateral Blade Plate Fixation♦

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INTRODUCTION: Tibiotalocalcaneal (TTC) arthrodesis is used to treat arthritis and/or deformity of the foot and ankle. Multiple surgical fixation options exist, including a 90º blade plate. The purpose of this retrospective review is to report the clinical outcome of TTC arthrodesis with lateral blade plate fixation.

MATERIALS AND METHODS: Between 1998 and 2010, 23 patients (mean age 59, mean BMI 30) underwent 25 TTC arthrodeses with lateral blade plate fixation. Preoperative diagnoses were post-traumatic osteoarthritis (10), atraumatic talar avascular necrosis (5), Charcot neuroarthropathy (3), idiopathic ankle OA (2), failed total ankle replacement (2), nonunion of ankle arthrodesis (2), and nonunion of TTC arthrodesis (1). Patient charts were reviewed at an average of 25 months postoperatively. Radiographs were available for review in 22 cases. Telephone interview was conducted for 15 of 25 procedures (13/23 patients).

RESULTS: Radiographic union was achieved at an average of 17 weeks in 16 of 25 patients (64%). Nonunion occurred at the ankle in 3 patients, at the subtalar joint in 2, and at both joints in 4. 8 of 9 nonunions underwent successful revision surgery. The remaining patient did not require revision. 16 of 25 procedures (64%) had at least one complication, while multiple complications occurred in 5 of 25 (20%). 13 of 25 surgeries (52%) required at least one re-operation, while 5 of 25 required more than one. 13 patients (15 TTC arthrodeses) were interviewed by phone at a mean of 44 months from the index procedure. Mean satisfaction was 9/10, and average current pain level was 2/10. All 13 patients would have the surgery again. Within the subset of patients interviewed by phone, 9 of 15 extremities (60%) went on to union after the initial procedure. 6 of 15 extremities currently used orthotic, brace, or shoe modification at least part of the time.

DISCUSSION: Tibiotalocalcaneal arthrodesis utilizing lateral blade plate fixation can be a challenging procedure as evidenced by high rates of complication. Despite this, once a solid fusion is achieved, patients demonstrate a high level of pain relief and satisfaction.

220. Does Modified Footwear Improve Gait After Ankle Arthrodesis?

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PURPOSE: The purpose of this investigation is to determine if the rocker bottom sole modification to shoes can improve the mechanical gait in patients after ankle fusion.

METHODS: A study group (SG) and a control group (CG) were identified. The SG consisted of patients who previously underwent ankle arthrodesis. Thirty-six patients were identified from an orthopedic registry at a Level I trauma center and were contacted to solicit interest in participation. Nine patients were available for participation. The CG consisted of nine individuals without previous lower extremity trauma. All participants completed the Short Musculoskeletal Function Assessment (SMFA) and the American Orthopaedic Foot and Ankle Society (AOFAS) questionnaires. All participants were video recorded while walking barefoot (BF) and while wearing rocker bottom shoes (RBS). These data were analyzed using a computer-based gait analysis software. Multiple angles of heel strike (HS), foot flat (FF), and toe off (TO) were measured from both groups while BF and while wearing RBS and then averaged. Total motion (TM) was averaged on each subject. Statistical analysis was carried out to compare differences among all groups. Mann-Whitney U analysis was performed on the questionnaires.

RESULTS: The SG scored statistically worse than the CG on the AOFAS questionnaire ($p<0.05$) and on every section of the SMFA ($p<0.05$). On average, the TM of the SG was 3.9º while BF and was 8.7º while wearing RBS, a difference of 4.8º ($p<0.05$). Shoe wear had no effect on TM in the CG ($p=0.59$). The motion increase of the SG wearing RBS was closer to the averages of TM in the CG while BF and while wearing RBS (11.3º and 11.0º respectively); however, the differences were statistically different from the CG values ($p<0.05$ for both). The velocity of gait did not statistically differ between the groups while BF ($p=0.70$) or while wearing RBS ($p=0.145$).

CONCLUSION: Patients who have had an ankle arthrodesis gain a statistically significant increase of total motion towards normal while wearing rocker bottom shoes.

221. Outcomes of the Bridle Procedure for the Treatment of Traumatic Foot Drop

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INTRODUCTION: There is a paucity of literature reporting the objective outcomes of the Bridle procedure (tri-tendon anastomosis between the posterior tibialis, anterior tibialis, and peroneus longus with subsequent insertion into the second cuneiform) for foot drop secondary to traumatic peroneal nerve palsy. The purpose of our study was to determine the level of function that could be expected for patients following this procedure.

RESULTS: Foot and Ankle Ability Measure (FAAM) for activities of daily living and sport subsections were 87.1% and 62.0%, respectively, compared to 99.6% and 98.0% for controls ($p<0.01$). This was statistically improved from the preoperative values. The AOFAS and Stanmore scores were 80.3 and 77.3, respectively, compared to 96.0 and 98.2 for controls ($p \leq 0.01$). Ankle dorsiflexion range of motion (ROM) was 56% ($p=.046$) of the uninvolved side and ankle plantarflexion ROM was 73% ($p=.18$).

Ankle dorsiflexion strength in the involved foot was restored to 37% of the uninvolved foot at 0º/second, 18% at 60º/second, and 14% at 120º/second ($p<.01$ for each). Ankle plantarflexion strength was 62% at 0º/second, 65% at 60º/second, and 61% at 120º/second ($p<.01$ for each) of the uninvolved side. Ankle power during heel rise was restored 36% compared to the uninvolved side and 34% compared to controls ($p<.01$). The heel rise test was completed with 1º of midfoot dorsiflexion in involved feet compared to 12º of midfoot plantarflexion in controls ($p<.01$).

All (100%) of the participants reported they would repeat the operation and were satisfied with their results, with 65% rating their outcome as “excellent” and 35% “good.” No patient wears an ankle foot orthosis (AFO) for everyday activities. Two of the 20 patients (10%) wear an AFO for recreational activities only. Nearly 50% of participants self report a limp when walking, 45% have a self-reported residual toe drag or steppage gait, and 90% of participants report they are unable to run or they “feel awkward” running.

Standing balance was assessed by limb reaching distance during the Star Excursion test. Bridle participants reached 85-90% of the distance in the anterior, middle, and posterior directions on the involved and uninvolved limbs compared to control participants.

222. Does Fibular Sesamoidectomy Cause Hallux Varus? Our Experience

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INTRODUCTION: Hallux varus is a complication occurring after a McBride's procedure and fibular sesamoidectomy has been thought to be the cause. The present study aims to evaluate the incidence of hallux varus after an isolated fibular sesamoidectomy.

METHODS: Hallux varus was the primary outcome variable. CPT codes were used to identify 14 patients (15 feet) who had received isolated fibular sesamoidectomy from January 2002 to December 2011. Electronic medical records including x-rays and office dictations at last follow-up were reviewed for evidence of hallux varus. Pre- and postoperative hallux alignment angles were calculated and any change towards varus was noted as were the pain scores.

RESULTS: There were 11 female patients and 3 males. The mean age at surgery was 44 years (range 17 to 72) years. The indication of sesamoidectomy was fracture (n=6), osteoarthritis (n=4), rheumatoid arthritis (n=2), AVN of the sesamoid (n=1), sesamoiditis (n=1), and plantar callosity (n=1). All patients had clinical follow-up. Six patients had only clinical follow-up, but no radiologic follow-up. The mean preoperative hallux valgus angle was 10.5˚ (±6.4˚). The mean postoperative hallux valgus angle was 10.8˚ (±5.88˚). There was no incidence of hallux varus. The average length of clinical follow-up was 39.5 weeks, and the average radiological follow up was 29.7 weeks.

CONCLUSION: Isolated fibular sesamoidectomy does not cause hallux varus.

223. Ankle Fusion Takedown and Conversion to a Total Ankle Arthroplasty

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BACKGROUND: Ankle arthrodesis is the standard treatment for end stage arthritis. It is not without significant morbidities such as adjacent joint arthritis, stress fractures, gait inefficiency, and limb length discrepancy. Converting a fusion to a total ankle arthroplasty is gradually becoming a more viable option for painful ankle fusions. The objective of this study was to evaluate the short-term outcomes of this procedure performed at our institute.

METHODS: Electronic medical records were accessed and a retrospective chart review identified 12 patients with this procedure. The final results were based on clinical and radiologic outcomes.

RESULTS: There were 11 females and 1 male in this study. The average age at ankle arthrodesis was 44 years (range 28-68 years). The average age at conversion to a total ankle arthroplasty was 50.7 years (range 40-77 years). The mean gap of time between arthrodesis and arthroplasty was 6.8 years (range 1-17 years). Out of 12 patients, one (Case 1) was lost to follow-up. Of the remaining patients, there was a mean clinical follow-up period of 18.5 months (range 6 months -35.6 months). One patient (Case 2) underwent a below knee amputation to treat unremitting pain, while another (Case 3) was contemplating an amputation for a similar problem. One patient (Case 5) had a loose tibial implant which was removed and converted to a tibiocalcaneal arthrodesis. The average tourniquet time for all patients was 116 minutes (range 59-142 minutes). On average, the remaining patients had a clinically measured range of motion of 37.2º, and had a well aligned, stable implant and a less painful foot at last follow-up.

CONCLUSION: Total ankle arthroplasty is a viable alternative to amputation for a painful ankle post-arthrodesis.

224. Analysis of Tibial Osteotomy Techniques for the Treatment of Foot and Ankle Disorders

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INTRODUCTION: Tibial osteotomy, though technically challenging, is a powerful method to treat a number of foot and ankle disorders, thereby providing deformity correction. Twenty-seven patients who underwent various osteotomy procedures (i.e., supramalleolar, diaphyseal, proximal metaphyseal) for various foot and ankle conditions were evaluated through a retrospective radiographic and medical record analysis. Patient complications and outcomes of these osteotomy procedures treated by both spatial frame (i.e., gradual correction) and open/internal fixation were assessed.

METHODS: Through an IRB-approved protocol, available radiographs and medical records of 27 patients who underwent tibial osteotomy procedures by the senior author were reviewed. Demographic, surgical, and radiographic data were collected for each case, including patient gender, BMI, injury/condition, time in frame/cast, occurrence of pin tract infection or fixation failure, and subsequent surgical procedures. Additionally, distal tibial articular angle and tibial length were measured on pre- and postoperative (most recent visit) radiographs.

RESULTS: Twenty-seven cases of tibial osteotomy procedures were retrospectively assessed (Table 1). In the spatial frame cohort (n=21), 11 males and 10 females were treated, with an average BMI of 28.1 (range, 15.7-45.2). The average time in frame was 186 days (range, 91-475). In the open/internal fixation cohort (n=6), two males and four females, with an average BMI of 34.5 (range, 24.4-39.9) were treated. The average time in cast was 38 days (range, 0-71). In this study population, the primary foot and ankle conditions treated by osteotomy included fracture malunion, fracture nonunion, tendon contracture, and cavovarus deformity.

Radiographically, the average distal tibial articular angles in the coronal and sagittal planes for the spatial frame cohort were 86.2 and 75.5, respectively, pre- and postoperatively. Pre- and postoperative tibial length was 37.8 and 39.3 cm, respectively. For the open/internal fixation group, the average distal tibial articular angles in the coronal and sagittal planes were 89.4 and 90.5, respectively, pre- and postoperatively. Tibial length, measured pre- and postoperatively, was 37.9 and 39.3 cm, respectively.

Pin tract infections, fixation failure, and fracture healing were the primary complications evaluated. Two pin tract infections (9.5%), three fixation failures (14.2%), and two tibial malunions (9.5%) occurred in the spatial frame cohort. No infections, fixation failures, or tibial non/malunions occurred in the open/internal fixation group; however, two patients required implant removal (33%).

CONCLUSION: Radiographs and medical records of 27 tibial osteotomy cases, treating multiple foot and ankle conditions, were analyzed to determine patient outcomes and complications. Proper deformity analysis, preoperative planning, and assessment of clinical variables such as soft tissue conditions as well as a familiarity with a variety of surgical techniques are necessary to treat these complex conditions.

Table 1: Description of Tibial Osteotomy Study Population

Fixation Method	**Tibial Osteotomy Type**	**Number of Cases**
Spatial Frame (Gradual)	Gigli distal tibia	12
	Drill hole distal tibia	5
	Gigli proximal tibial	2
	Drill hole proximal tibia	1
	Bone transport proximal tibia	1
Open/Internal Fixation	Open distal tibia wedge	3
	Open distal tibia dome	3

225. Effects of First Ray Instability on Midfoot Joint Forces and Forefoot Ground Force Distribution: A Cadaver Study

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INTRODUCTION: The motivation for this study is the clinical observation that patients with first ray instability develop arthritis in a predictable pattern in the midfoot. Cartilage wear is typically seen in the dorsal and medial in the 1st naviculocuneiform (NC) joint and dorsally in the 2nd tarsometatarsal (TMT) joint. It is the senior author's belief that intercuneiform instability plays an important role in the development of this arthritis pattern. The purpose of this study was to quantify the effect of 1st ray instability on specific joints in the midfoot. A secondary goal of the study was to evaluate the change in forefoot ground force with 1st ray instability.

METHODS: Eleven fresh frozen human cadaver leg specimens were tested. All specimens were sectioned at the mid tibia level and muscle tendons were dissected out and tensioned with a weight and pulley system to simulate muscle forces. The specimens were mounted in a dynamic compression testing machine (Test Resources) and cyclical compressive forces applied. A foot sensor (TekScan) recorded the ground reaction forces and paddle sensors (TekScan) measured joint forces in the 1st NC joint and the 2nd TMT joint. The sequential transection of ligaments around the medial cuneiform was performed to destabilize the first ray, with data collected after each dissection. Specifically, the dorsal intercuneiform ligament was transected, followed by the plantar intercuneiform ligament, followed by the intermetatarsal ligaments and the plantar NC ligament. The joint sensor data was collected as the maximum force measured in a four-pixel area (~2 mm x 2 mm). Foot sensor data was collected as force was applied to the 1st ray forefoot and lateral forefoot. This was analyzed both as total force, and percentage of forefoot force. Data from all 11 specimens was analyzed for our results.

RESULTS: The measured peak force in the 1st NC joint increased by 84% with sequential destabilization of the 1st ray and reached a maximum value with the plantar NC ligament intact ($p=0.02$). The measured peak force in the 2nd TMT joint increased slightly, then decreased with sequential destabilization of the first ray. This result was not statistically significant. Destabilization of the 1st ray decreased the force transmitted to the medial forefoot in 9 out of 11 test samples. On average, the total force to the first ray forefoot decreased by 29%, though this result was not statistically significant ($p=0.25$).

We were able to show that with destabilization of the 1st ray, the peak pressure in the 1st NC joint had a statistically significant increase. We were not able to show an increase in the peak force in the 2nd MT joint as theorized; however, this joint was very small and difficult to access with our current sensors. We showed that destabilization of the 1st ray decreased the force transmitted to the medial forefoot in 9 out of 11 test samples, supporting the concept of lateral forefoot overload in patients with 1st ray instability. On average, the total force to the 1st ray forefoot decreased in our specimens, but this result was not statistically significant. In general, there was a wide range of recorded values across specimens, making standard deviations high, and statistical significance difficult to achieve. This is likely due to some fault of our cadaveric model and measurement methods.

CONCLUSION: In a cadaveric model, destabilization of the 1st ray increases the peak force in the 1st NC joint. In the forefoot, a trend was seen towards decreased force in the 1st ray, but this trend was not statistically significant.

HAND

1-AB Long-Term Outcomes After Radiocarpal Dislocation: A Prospective Review

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HYPOTHESIS: Early recognition and treatment of radiocarpal dislocation results in improved functional outcomes compared to delayed treatment and partial or complete wrist fusion.

METHODS: A retrospective review was conducted analyzing the outcome of patients treated with radiocarpal dislocations from 1979 to 2010. All patients had a minimum of two years of follow-up. Outcome assessments included wrist range of motion, grip strength, Mayo Wrist Score, Patient-Rated Wrist Evaluation (PRWE), and Disabilities of the Arm, Shoulder, and Hand (DASH) score. Statistical analysis was performed with the Student's t test.

RESULTS: Sixteen patients were followed for a mean of 14 years. Thirteen wrists were treated acutely (within 4 weeks of injury) and 3 treated after a delayed presentation (greater than 4 weeks). Two patients initially treated with closed reduction and casting or percutaneous pinning went on to salvage procedures including a proximal row carpectomy and a radioscapholunate fusion, respectively, an average of 5 months later. Another patient treated with primary ligament repair went on to scapholunate ligament reconstruction at 5 weeks following injury. Compared to patients treated with early open reduction, internal fixation and repair of ligaments, those that were treated with acute partial or complete wrist arthrodesis or delayed repair had inferior DASH and PRWE scores. Regardless of the time to presentation, patients treated with ligament reconstruction or repair had improved DASH and PRWE scores compared to those who underwent percutaneous pinning only or partial or complete wrist fusion (DASH [4.9 vs. 17.1], PRWE [12.8 vs. 15.1]).

CONCLUSION: Radiocarpal dislocations result in significant osseous and ligamentous injury to the distal radius and carpus. Early recognition and treatment of radiocarpal dislocations with open reduction, internal fixation, and repair of ligaments results with improved functional outcome scores. Delay in treatment and partial or complete wrist arthrodesis leads to suboptimal long-term outcomes.

SHOULDER

2-AB The Terrible Triad of the Shoulder Revisited: Outcomes Are Worse Than Realized

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HYPOTHESIS: The terrible triad of the shoulder was defined two decades ago as a combination of anterior shoulder dislocation, rotator cuff tear, and neurologic injury. Current literature regarding this injury consists of small case series and case reports, focusing on older patients prone to rotator cuff injuries with relatively good neurologic recovery. We hypothesize that younger patients with terrible triad injuries will have worse outcomes.

METHODS: A retrospective review was undertaken of patients between 2000 and 2010 who presented with the above constellation of injuries. Eleven patients were identified, all of whom underwent evaluation by fellowship-trained hand and shoulder surgeons. An MRI of the shoulder and subsequent rotator cuff repair was performed in all patients. EMG and nerve conduction studies were also performed. Surgical neurolysis was undertaken for patients with no evidence of reinnervation at six months post-injury. If the nerve was not in continuity or was unable to conduct an intraoperative action potential, nerve transfer or nerve grafting was performed. Charts were reviewed for demographic data, injury mechanism, characteristics of rotator cuff tear, delay from injury to treatment, and shoulder ROM.

RESULTS: A total of 11 patients with an average age of 47 years met the inclusion criteria, the majority of which sustained injuries via high energy mechanisms. All patients had an axillary nerve injury; 9 (82%) did not show evidence of recovery. Six of the patients without evidence of recovery underwent nerve grafting or transfer procedures. Seven patients had additional suprascapular nerve injuries, and one each had musculocutaneous, radial, and ulnar nerve injuries. All of these showed partial or full recovery. Average preoperative/postoperative ROM was: forward flexion: 28°/58°, abduction 15°/54°, and external rotation 12°/26°.

CONCLUSION: Our series of patients with the terrible triad of the shoulder consisted of younger patients with more severe injuries. In contrast to previously reported smaller case series, the majority of our patients did not spontaneously recover axillary nerve function and required surgery.

3-AB Native Version Humeral Head Cutting Guide: Individualized Version Alignment in Shoulder Arthroplasty

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INTRODUCTION: An instrument was created as a means to recreate the native version of an individual patients' humeral neck intraoperatively. The instrument was designed to allow the surgeon to correctly broach and place the humeral component as well as to make an anatomically correct neck angle cut. The instrument requires no intraoperative fluoroscopy, and no CT scans or other preoperative planning. Many techniques have been adopted for humeral alignment. Almost all of these techniques attempt to recreate the average humeral retroversion of approximately 20º-30º. This process is inherently flawed as the native version of the individual can differ significantly with as much as 50º of variability. Our purpose was to use the alignment instrument and anatomically reproduce the native version with the implantation of the humeral component.

METHODS: Fresh frozen cadaveric humeri were dissected and CT scanned. With the use of a total shoulder surgical set, the neck and head of each humerus were aligned with the version instrument. The instrument then guided our humeral neck cut, the broaching process, and the final broach placement in the humeral canal. With the broach in place, the humeri were CT scanned again. Version angles were calculated using an angle from the bicipital groove and intersected the center of the humeral head and neck preoperatively and postoperative intersected the center of the implanted broach neck.

RESULTS: The left humerus pre-procedural angle measured 127.7º +/- 2.2º and the left humerus post-procedural angle measured 124.7º +/- 1.6º. The right humerus pre-procedural angle measured 126.6º +/- 1.9º and the right humerus post-procedural angle measured 127.5º +/- 1.1º.

DISCUSSION AND CONCLUSION: The alignment instrument was able to recreate the native version of the humeral head within 2º to 3º. Restoration of a version angle through an accurate neck cut and properly aligned implant helps recreate the individuals' anatomic alignment and likely reduces the incidence of complications and more closely restore the anatomy and native biomechanics of the shoulder.

FOOT AND ANKLE

4-AB Proximal Phalanx Structural Integrity in Flexor to Extensor Tendon Transfer: A Biomechanical Study

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INTRODUCTION: The flexor to extensor transfer of the flexor digitorum longus (FDL) tendon is a common operative procedure for the treatment of a flexible hammer toe deformity and chronic metatarsophalangeal (MTP) dislocation. A rare complication of this procedure is iatrogenic fracture through the drill hole site for the tendon transfer. The purpose of this study is to fully understand the force necessary to create a fracture through the average proximal phalanx, with a drill hole being placed through it, and correlate that force to the percentage of bone remaining after the drilling process.

METHODS: The second, third, and fourth toes of 14 fresh frozen cadavers were dissected and the proximal phalanx was removed. The right or left foot proximal phalanxes of each cadaver were then drilled with a 3.5 mm drill as would be done in a tendon transfer procedure. The opposite foot non-drilled bones were used as matched controls for the drilled bones. Radiographs of the bones were taken and the dimensions of the proximal phalanx were measured at the drill hole site or where the drill hole would be placed. The area and volume of bone, volume of the drill hole, and percentage of bone remaining with the drilled hole were all calculated. The bones were then tested for load to failure using a biomechanical testing apparatus.

RESULTS: The drill hole resected approximately 25-30% of the volume of bone out from the area of bone. The average decrease in load to failure of the second through fourth toes after drilling was 89.8%, 75.8%, and 63.3% versus controls. Five out of six toes with diameters less than 6 mm fractured with less than 100 Newtons of force. Fifteen of the 18 toes that were drilled fractured at the drill hole site, and 3 of the drilled toes fractured at a location not involving the drill site.

DISCUSSION AND CONCLUSION: The bone diameter was the main determinant of the strength of the structure to withstand the forces applied to it with the drill hole further weakening the bone. In preoperative planning for a flexor tendon transfer, a radiograph of the digit in question should allow the surgeon to analyze the dimensions of the digit and decide if the proximal phalanx is capable of withstanding a drill hole.

5-AB Reconstruction of Chronic Instability of the Syndesmosis with Open Reduction and Endobutton Stabilization

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BACKGROUND: Chronic instability of the syndesmosis after rotational ankle fracture compromises function and poses a challenge to a successful outcome. Recently, excellent results with arthrodesis of the syndesmosis have been reported. However, the unknown effect of a complete loss of syndesmotic motion on ankle function remains a concern. This study retrospectively reviewed clinical and radiographic results after reconstruction of chronic instability of the syndesmosis with open reduction and stabilization with a suture-endobutton device.

METHODS: Five patients diagnosed with chronic instability and malposition of their syndesmosis underwent reconstruction. Five parameters of ankle and syndesmotic alignment were measured on weight-bearing radiographs obtained preoperatively and at latest follow-up. AOFAS functional rating scores before and after this procedure as well as satisfaction and willingness to repeat their surgery were culled from the patient's records. Statistical analysis with paired t-tests at a significance of $p \leq 0.05$ was performed on the data.

RESULTS: At a mean follow-up of 32 months (range 22 to 38 months), AOFAS scores improved from 49 to 75 points (p-value 0.018). No significant difference was detected in radiographic parameters measured pre- and postoperatively. All patients were satisfied with their outcome and would repeat the surgery under similar circumstances.

DISCUSSION AND CONCLUSION: Based on the results in this small cohort, reconstruction of chronic instability of the syndesmosis with open reduction and stabilization with a suture-endobutton significantly improves the function of the ankle. Endobutton stabilization avoids the complete loss of motion and may offer an alternative to arthrodesis of the syndesmosis.

6-AB Results of Total Ankle Arthroplasty with the Agility LP System

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INTRODUCTION: Total ankle arthroplasty (TAA) is a unique solution for end stage arthritis of the ankle. The results and success rate, however, tend not to mirror those achieved for total hip and knee arthroplasty. Talar subsidence is a major cause of TAA failure. The Agility LP TAA system is a newer design (approved by the FDA in 2007) which seeks to prevent talar subsidence and promote implant ingrowth through greater coverage of the talar head, thus distributing compressive stresses more evenly. This study aims to determine the subjective and functional outcomes of patients with the Agility LP prosthesis.

METHODS: This study has retrospective as well as prospective arms. After using CPT codes and then applying exclusion criteria, 23 patients (24 ankles) were identified who underwent TAA using the Agility LP prosthesis between February 2007 and July 2009. These patients were asked to return to the office for x-rays and a clinical examination. A subjective evaluation was performed with SMFA, SF-36, AOFAS, VAS, and a patient response questionnaire.

RESULTS: This study had 12 female patients and 11 males (n=24, Case 23 was bilateral). The average age of the patients was 63 years (range, 36-83 years). The average follow-up was 3.48 years. There was a significant difference between the pre- and postoperative VAS scores ($p<0.001$). The average preoperative range of motion ($35.8^\circ \pm 38.3^\circ$) was also significantly different from the average postoperative range of motion ($21.3^\circ \pm 19^\circ$) ($p=0.006$). There was no significant difference between AOFAS and VAS scores of patients with implant ingrowth and implant subsidence ($p=0.18$). The study did not find any correlation between the patients' age and BMI and final AOFAS/VAS scores. The VAS ($p=0.326$) and AOFAS ($p=0.242$) scores did not differ significantly based on the etiology of arthritis or the heel alignment at last follow-up. One patient (Case 14) was revised to an ankle arthrodesis, while another (Case 16) had revision of the talar component due to subsidence. The failure rate was 2 out of 24 (8.33%) at last follow-up. The implants showed bony ingrowth in 15 cases, talar subsidence in 6 cases, and tibial subsidence in 2 cases. Twenty patients (21 ankles) were satisfied with the outcome of their surgery while, 19 (20 ankles) patients said they would undergo the procedure again.

CONCLUSION: Total ankle arthroplasty using the Agility LP system is effective in reducing pain due to ankle arthritis, albeit at the cost of a reduced range of motion postoperatively. The revision and reoperation rates for this implant are comparable to those reported in the literature.

7-AB The Longitudinal Lisfranc Variant

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A Lisfranc injury generally refers to an injury to the base of the metatarsals, their articulations with the tarsal bones and their ligamentous attachments. Most TMT joint injuries result from a horizontally-directed force in which the metatarsals have displaced relative to the midfoot. Current classification systems describe injuries to the tarsometatarsal joint, but not the medial displacement of the first ray.

The injury pattern that we describe is one of a longitudinally-directed force through the first ray and cuneiform. We propose a way to characterize this Lisfranc injury variant from plain radiographs in order to recognize the injury and decide the treatment plan. We propose a simple radiographic parameter to quantify this injury variant and also suggest treatment options based on the measurement.

A reliable measure for us has been on an anterior-posterior (AP) weightbearing radiograph the height difference between the distal articular surfaces of the first and second cuneiform bones. This measure helps identify subtle longitudinal TMT injury variants in which there is a proximal and medial subluxation of the first cuneiform – metatarsal complex.

After initial work-up, our treatment for this injury variant is conceptually the same as with transverse Lisfranc injuries. Our patients undergo open reduction internal fixation. Intercuneiform, navicular-cuneiform, and occasionally second metatarsal-medial cuneiform screws are used to obtain anatomic fixation. Restoring the anatomic alignment is crucial in treatment of this injury.

The longitudinal Lisfranc variant is often a subtle injury to identify. Delayed diagnosis and treatment has been associated with poor results and significant functional consequences. We have described a simple radiographic measurement to recognize the subtle longitudinal injury pattern that will help guide its treatment options.

TUMOR

8-AB A Novel Murine Model of Post-Radiation Osteonecrosis Following Simulated Soft-Tissue Sarcoma Resection

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INTRODUCTION: Radiation therapy (XRT) following soft-tissue sarcoma excision is associated with a significant incidence of postoperative femur fracture due to post-radiation osteonecrosis. The natural history of post-radiation osteonecrosis in this context is currently not well understood. We propose a relevant mouse model that will explain the structural and mechanical alterations that result from XRT following sarcoma resection.

METHODS: Eighty mice underwent simulated soft-tissue sarcoma resection of the thigh, and were placed in either a surgery-alone control group or 1 or 3 experimental groups. Each experimental group received postoperative XRT (20 Gray), one group had received 4 weeks of preoperative zoledronic acid (ZA), and one group underwent periosteal stripping. The contralateral femur served as an internal control. Mechanical testing, microCT analysis, and histology were performed at post-radiation timepoints of 2, 6, 12, and 26 weeks to determine changes in bone properties and structure. The effects of radiation, periosteal stripping, and ZA usage were assessed using analysis of variance (ANOVA) with $p < 0.05$ considered significant.

RESULTS: Irradiated femora had significantly increased bone strength (24.9 N vs. 21.2 N, p=0.013) and stiffness (145 N/mm vs. 121 N/mm, p=0.012) compared to the controls at the two-week timepoint. At six weeks, experimental femora similarly demonstrated significantly increased stiffness (p=0.004) and trended toward an increase in bone strength (p=0.062). Bone strength in irradiated femora decreased over time from 2 weeks (24.9 N) to 6 weeks (22.2 N), but it was not statistically significant (p=0.068). ZA treatment increased bone strength compared to other experimental femora, but this change was not statistically significant at 6 weeks (24.1 N vs. 21.5 N; p=0.19). There was no significant difference due to periosteal stripping at 2 weeks or 6 weeks. Data from subsequent time points are currently being analyzed.

CONCLUSION: The proposed murine model is a valid model with which to study the effect of postoperative radiation therapy on long bones following a simulated soft-tissue sarcoma resection.

SPORTS

9-AB Contribution of Tension-Reducing Rotator Cuff Sutures on Plate Fixation of Proximal Humerus Fractures

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INTRODUCTION: Proximal humeral fractures are 5% of extremity fractures, occurring most commonly in the elderly. Common surgical options include open reduction internal fixation (ORIF) with fixed angle locked plating; however, there is an associated 43% failure rate into varus. The addition of tension reducing sutures from the plate to the rotator cuff may attenuate the deforming forces of the rotator cuff resulting in decreased varus failure. In this study, we investigate the biomechanical contributions of tension reducing sutures to the locked plate construct.

METHODS: Two fixation techniques were tested in 12 matched fresh frozen humeri in which standard two-part fractures of the surgical neck were created with a gap simulating surgical neck comminution. In group 1 (n=6), fractures were fixed with a standard proximal humerus locking plate. In group 2 (n=6), the plate fixation was similar and also tension-reducing sutures were applied from the plate to the rotator cuff. Active abduction was simulated for 400 cycles. Change in displacement and load to failure of the constructs were recorded.

RESULTS: The addition of tension reducing sutures did not lead to significant differences in the fracture gap. The mean change in displacement during testing was 0.05 mm in group 1 and 0.5 mm in group 2. Load to failure in group 1 was 342.5N and in group 2 was 351.3N. Failure typically occurred at the rotator cuff testing clamp as seen in most specimens.

CONCLUSION: The addition of tension reducing sutures to locked plate fixation of a two-part proximal humerus fracture does not result in decreased fracture gap deformation or alteration of load to failure. While additional studies are necessary to evaluate the long-term clinical outcome of the tension reducing sutures as well as their applicability in three- and four-part fractures, there does not appear to be any biomechanical advantage in the acute postoperative period.

11-AB Epidemiology and Outcomes of Concussions in Major League Baseball

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The most common head injury in athletics is a concussion. All contact sports carry the risk for such injuries, but a paucity of data exists on concussions in baseball, particularly at the professional level. The purpose of this study is to document the epidemiology of concussions in Major League Baseball (MLB) and to quantify the impact of these injuries upon player performance. Data on MLB concussions occurring between 2001 and 2010 was gathered from official MLB disabled list records, game summaries, and player profiles. Performance statistics (batting average, on-base percentage, slugging percentage, earned run average, and walks plus hits per inning pitched) were compiled for each player for the 15- and 30-day periods immediately after they returned to play. Identical statistics from the 30-days immediately pre-injury served as a control. Statistical analysis was performed using two-sided z-test for proportions with alpha=0.05. Thirty-three concussions in MLB players were identified, 8 from 2001-2005 (per game incidence=0.03%) and 25 from 2006-2010 (per game incidence=0.10%). Average age at time of injury was 29 years. Nine players were concussed by batted balls (27.3%), 8 by pitched balls (24.2%), 7 by fielder-runner collisions (21.2%), 6 by fielder collisions (18.1%), and 3 by swung bats (9.1%). Nearly a third (30.3%) of injuries were to catchers. On average, players were unable to play for 67 days (range 1-349) or 38 games (range 1-152) after a concussion. Four players (12.1%) never returned to MLB. Slugging percentage through the first 15 days back from injury (0.358, p=0.013) was significantly decreased from pre-injury (0.412) levels, but not through the first 30 days (0.393, p=0.290). No significant differences were found between pre- and post-injury performance in regards to batting average, on-base percentage, earned run average, or walks plus hits per inning pitched. In conclusion, the recognition and reporting of concussions in MLB appears to be increasing, with a near three-fold increase in just the past five years. The impact of this injury can be significant, resulting in lengthy time on the injured list, temporary performance decreases, and even the end of careers.

12-AB Evaluation of Hip Internal and External Rotation Range of Motion as an Injury Risk Factor for Hip, Abdominal, and Groin Injuries in Professional Baseball

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INTRODUCTION: Normal hip range of motion (ROM) is essential in running, changing directions, and transfer of energy from lower to upper extremities during throwing. Dysfunctional hip ROM will alter kinematics and increase risk of injury and disability in athletes. The purpose of this study is to evaluate the effect of hip internal and external ROM (Arc) and risk of injury (hip, hamstring, and groin) in professional baseball players.

METHODS: Bilateral hip internal and external ROM was measured on all baseball players (N=209) in one professional organization (major and minor league) during spring training by several fellowship-trained orthopedic surgeons. Players were organized according to their respective positions. Specific injury (hip, hamstring, and groin) along with the number of days missed was documented prospectively for an entire season (2010 to 2011). Data was analyzed according to the position and type of injuries during the season. Statistical analysis was performed.

RESULTS: Total number of players is 209 with an average age of 24 +/- 3.6 (range=17-37). Both pitchers and catchers had significantly decreased mean internal rotation and overall arc of motion compared to the positional players. Players with a history of hip or abdominal injury also had decrease in their hip arc of motion compared to the normal group. Catchers with in-season injuries (N=14) had decreased hip arc compared to catchers without in-season injuries (N=8). Players with hip, hamstring, and groin injury also had decreased hip arc when compared to the normal group (not significant). Based on ANOVA analysis, both younger-aged and positional players have higher relative risk of developing hip/hamstring/groin associated injuries.

CONCLUSION: There is a correlation between decreased hip internal rotation and total arc of motion with hip, hamstring, and groin injuries. Both catchers and pitchers have overall decreased hip arc ROM when compared to the positional players. Players with history of hip injuries also have decreased hip IR and arc of motion compared to normal group. Younger age and positional players have higher relative risk for hip/hamstring/groin injuries.

PEDIATRICS

13-AB Extreme Femoral Shortening: An Approach to the Chronically Dislocated Hip in the Non-Ambulatory Pediatric Population

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BACKGROUND: Hip subluxation and eventual dislocation is a common problem in patients with neuromuscular spasticity. Many surgical techniques have been described for the painful chronically dislocated hip in this population, but each has been reported with significant complication rates. The purpose of this study was to investigate the outcomes of a novel technique, an extreme varus femoral shortening.

METHODS: After IRB approval was obtained, patients were identified retrospectively by surgical codes. The medical records were reviewed for range of motion, pain and functional assessment, surgical indications, complications, and results. The preoperative and postoperative radiographs were assessed. Caretaker questionnaires were also collected and reviewed.

TECHNIQUE: The operation consisted of a lateral proximal femoral approach and an average 5 cm varus osteotomy of the subtrochanteric femur. A fixed angle dynamic condylar screw implant was then applied as internal fixation. The patients remained in the hospital, on average, for three days for standard postoperative care.

RESULTS: From 2001 to 2010, six femoral shortening osteotomies were completed in five non-ambulatory patients with neuromuscular spasticity by one surgeon. Two males and three females were followed for a minimum of two years (range: 2-8 years). All of the patients suffered from pain preoperatively, and following the procedure had substantial improvement. Only 1 of the 5 patients was unable to sit postoperatively; however, this was secondary to severe lower extremity contractures. All caregivers noted improvement in ease of hygiene and transfers. There were no postoperative complications such as wound infections, deep venous thrombosis, hardware failure, or increased pain. One patient had mild heterotopic ossification incidentally noted on routine follow-up examination.

CONCLUSIONS: Extreme femoral shortening provides non-ambulatory children with symptomatic hip dislocations due to neuromuscular spasticity, a reproducible way to alleviate pain and improve ease of hygiene.

14-AB The Post-Traumatic Proximal Cross Union of the Forearm in Childhood. What Is Recommendable?

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INTRODUCTION: The post-traumatic proximal cross union of the forearm in childhood is a rare complication after radial head and neck or proximal forearm fractures and elbow dislocations. No standardized treatment exists, and several operative procedures with or without interposition techniques are described in the literature. We analyzed all children which were treated operatively in our institution during the last 13 years.

METHODS: From 1998 to 2011, 8 children with post-traumatic proximal cross union of the forearm (Type 3 according to Vince and Miller) were treated operatively with a resection of the cross union or the radial head.

Average age at the time of initial trauma was 9 years ± 2.56, average age at the time of operative treatment was 11.86 years ± 3.09. Earliest excision of the cross union was performed two months after fracture, the latest after six years. Additionally, one child had a nonunion of the radial neck and a cross union. The follow-up time was 10.6 months (1-36 months).

RESULTS: Six patients had a resection of the cross union without any interposition. In three cases, an arthrolysis of the elbow was done. One case had an interposition of a local fascia flap. In two cases, a primary excision of the radial head after several years after trauma was performed. Three children had failed resection of the cross union and had repeat surgery for recurrence.

All patients had NSAID therapy after surgery, a postoperative radiation was performed three times.

The mean ROM for pronation and supination was 30/0/50° based on a fixed position of 0° preoperatively.

DISCUSSION: There is still a controversy about the best procedure regarding the cross union even in childhood. Many procedures are described in case reports and small case series. We recommend the resection of the cross union without necessarily an interposition. If the cross union exists for several years with ankylosis of the elbow and bony deformities of the proximal radius, an excision of the radial head as a salvage procedure is recommendable.

TRAUMA

15-AB A Clinical Evaluation of Alternative Fixation Techniques for Medial Malleolus Fractures

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OBJECTIVES: The purpose of this study is to report the outcomes of patients with medial malleolar fractures treated with headless compression screws in terms of union rates, the need for hardware removal, and pain over the hardware site.

METHODS: After IRB approval, a review of medical records and radiographs was performed on patients with ankle fracture patients admitted to our Level I Trauma Center from 2007-2010. Patients were included in this study if they had headless compression screw fixation for the medial malleolus fracture in addition to follow-up until full weightbearing and fracture healing.

RESULTS: A total of 64 patients were treated with headless compression screws and 44 had adequate follow-up for inclusion. There were 17 males and 27 females with an average age of 45 (range:18-80). There were 23 patients with bimalleolar fractures, 14 with trimalleolar fractures, and 7 with isolated medial malleolar fractures. The average follow-up was 35 weeks (range: 12-208 weeks). No patients requested/required hardware removal for prominence. One patient (2%) had a delayed union, which healed without additional intervention. Ten patients (23%) reported mild discomfort to palpation over the medial malleolus.

CONCLUSION: The current standard of treatment for medial malleolus fractures is reduction and fixation using partially threaded screws and/or Kirschner wire fixation. However, there have been reports of nonunion rates up to 20%. In addition, the patient may complain of prominent hardware. Headless compression screws have been used successfully for treatment of various fractures. Our series found treatment of medial malleolus fractures using headless compression screws resulted in good outcomes with no patient in this series with elective hardware removal for prominence and all medial malleolus fractures healed. The headless compression screw provides a viable alternative in medial malleolus fracture fixation.

16-AB Geriatric Polytrauma with Orthopedic Injuries: Is Operative Fixation a Death Sentence?

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PURPOSE: To study factors that increase the mortality of elderly polytrauma patients with associated orthopedic injuries and the impact of operative fixation.

METHODS: A Level I trauma center registry was queried to identify geriatric patients (age of 65 or greater) between 2004 and 2010 who presented as a polytrauma patient with associated orthopedic injuries. Patients were excluded if they had severe head and spine injuries, death on arrival, or had low energy mechanisms of injury. A retrospective chart review was then completed and logistic regression was conducted to identify factors that predict mortality.

RESULTS: There were 154 patients that comprised our study group. Overall, 52 patients died within one year of their admission; 21 patients who died during their initial hospital stay and 31 patients died within one year following admission. Sixty-four patients underwent operative stabilization of their orthopedic injuries. Increased mortality was seen ($p<0.05$) in female patients, those with lower admission GCS, and those that underwent orthopedic surgery. These patients had an increased risk of developing pneumonia and/or deep venous thrombosis. Regarding their orthopedic injuries, patients had worse outcomes ($p<0.05$) if they sustained spine or pelvic/acetabular fractures that required surgery, as well as femur, foot and ankle, clavicle, or scapular fractures.

CONCLUSION: The effect of orthopedic injuries including lower extremity, spine, pelvis, and acetabular fractures in this geriatric polytrauma group contribute to worse outcomes compared to a younger cohort. Also, clavicle fractures serve as an important injury marker demonstrating higher mortality rates, indicating a high energy mechanism of injury. Our study found those patients with orthopedic injuries requiring surgical stabilization fare worse than those not undergoing orthopedic procedures. Thoughtful risk/benefit consideration is suggested when contemplating operative intervention in these patients.

17-AB Evaluation of the Utility of the Wells Score for Predicting Pulmonary Embolus in Patients Admitted to the Orthopedic Trauma Service

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INTRODUCTION: The decision to perform computed tomography pulmonary angiography (CTPA) to diagnose pulmonary emboli (PE) in orthopedic trauma patients is challenging. Although accurate diagnosis is important, CT scans expose patients to radiation, are costly, and false positive results may lead to unnecessary anticoagulation. Scoring systems such as the Wells score have been established to assign risk categories for patients suspected of PE to assist in determining need for CTPA. The utility of the Wells Score for predicting PE in spine surgery patients has not been described.

METHODS: We retrospectively identified 6,854 patients who were admitted to the orthopedic trauma service between 2001-2011. Of these, 160 trauma patients underwent CTPA for clinical suspicion of PE. The Wells Score was calculated for each patient who had CTPA based on a retrospective chart review. Risk categories utilizing the “traditional” and “alternative” interpretations of the Wells score were evaluated for effectiveness in predicting PE. Wells score and risk category were compared for patients with CTPA positive or negative for PE.

RESULTS: PE was diagnosed in 25/160 (15.6%) patients who underwent CTPA. In total, 25/6,854 (0.36%) patients admitted to the orthopedic trauma service were diagnosed with a PE. The mean time to diagnosis following surgery was 5.68 days. The mean Wells Score for patients diagnosed with PE was 2.9 compared 3.4 for those without PE (p=0.860). Neither the “traditional” nor the “alternative” interpretation of the Wells score was predictive of positive CTPA scan for PE (p=0.726, p=0.601). Mean billing amount for the CTPA exam was $2,112.

CONCLUSION: This study examined the utility of the Wells score as a predictive tool of diagnosing PE in patients admitted to the orthopedic trauma service; 15.6% of CTPA scans were positive for PE. We found no statistically significant correlation between the Wells Score and the results of CTPA. Further study is needed to develop a predictive scoring system for assessing risk of PE in orthopedic trauma patients to better define the effective use of CTPA.

18-AB Fibular Shaft Allograft Support of Posterior Joint Depression in Tibial Plateau Fractures

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PURPOSE: Posterolateral joint depression in the setting of a tibial plateau fracture can be difficult to manage. This study aims to (1) characterize the ability of lateral-based, pre-contoured plates to support posterolateral joint depression and (2) describe and clinically assess a new technique performed through a lateral approach, which allows for reduction and support of posterior depression in tibial plateau fractures.

METHODS: Six, pre-contoured, lateral-based, tibial plates from five manufacturers were tested in sawbones models. The location of the posterior-most rafting screw was determined and the distance from that screw to the most posterior edge of the lateral tibial plateau was measured utilizing a digital caliper system. A retrospective review was then performed of the first 11 cases at our institution where a fibular shaft allograft was utilized to reduce and support posterolateral joint depression associated with an acute tibial plateau fracture. Radiographic measurements were used to quantify the joint depression before and after surgical intervention, and at the most recent follow-up. Time to union and postoperative knee range of motion were also noted.

RESULTS: The tibial plates tested left 40% of the lateral plateau unsupported. Between 2008 and 2010, 11 patients with a mean age of 50.5 years were treated with posterolateral fibular strut augmentation. The average follow-up was 11 months. All fractures united at a mean of 3.4 months. The average joint depression was 11 mm prior to definitive surgical intervention and 0.8 mm at the most recent follow-up. The mean postoperative range of motion was 2° to 119°. Two complications occurred: one postoperative arthrosis and one late infection.

CONCLUSIONS: Fibular shaft allografts can be used in the treatment of posterolateral joint depression caused by tibial plateau fractures with success. The graft serves as a reduction tool and structural support during fracture union. The results of this case series demonstrate a union rate of 100% and maintenance of the restored joint line in 82% cases without further patient morbidity attributable to an additional posterolateral approach.

19-AB Ligamentous Contribution to Pelvic Stability in an Open-Book Injury

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PURPOSE: The purpose of this study was to evaluate the relative contributions of the pubic symphysis (PS), sacrotuberous (STL), and sacrospinous (SSL) ligaments, and anterior sacroiliac ligament (ASIL) to pelvic ring stability in a rotational, open-book pelvic ring injury.

METHODS: Six cadaver pelves were harvested with all ligaments intact and divided into two groups. In group one, ligaments were sectioned in sequence of PS, STL, and SSL, then ASIL. In group two, the PS was sectioned followed by ASIL, then the STL and SSL. First, the contralateral hemipelvis was fixed to a table using a jig. Next, the PS was sectioned. Then, a manual external rotational force was applied through the unfixed ilium under fluoroscopy. At the point of maximal displacement, a permanent AP image was obtained and magnification corrected horizontal (H) and vertical (V) displacements relative to the AP plane were measured. This technique was then repeated after sequential sectioning of each ligament. Statistical analysis was utilized to evaluate the contributions of each ligament within each group and between each group.

RESULTS: The displacement after initial PS sectioning was not significantly different when comparing group one to group two and in both groups, a significant progressive increase in displacement was noted when the PS (H and V displacements $p<0.05$) and ASIL (H and V displacements $p<0.05$) were sectioned. However, there was no significant change noted with SSL/STL sectioning in either group (H and V displacements $p>0.05$).

CONCLUSIONS: The PS and ASIL are important in maintaining pelvic ring external rotational stability. However, the SSL/STL complex has little, if any, effect in this regard. Due to the bony orientation of the SI joint, external rotation of the hemipelvis, as in open-book injury, will show vertical as well as horizontal displacement on the AP radiograph, despite the PSIL being intact.

20-AB The Effect of Lateral Lumbar Interbody Fusion on Sagittal Balance and Spinopelvic Parameters in Degenerative Scoliosis: A Case-Control Study

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INTRODUCTION: Use of the lateral lumbar interbody fusion (LLIF) technique to restore sagittal balance in patients with lumbar spinal deformity is controversial and not well studied. A matched cohort analysis was performed to investigate the effect of LLIF on sagittal balance.

METHODS: Between 2008-2011, 33 patients underwent combined anterior lumbar interbody fusion, LLIF techniques for adult degenerative scoliosis. Mean patient age was 65.9 ± 7.8 years. LLIF was performed at a mean of 5.5 ± 2.0 levels for thoracic and lumbar disks levels per patient (total 181 levels) with a mean of 3 ± 1 in the lumbar spine. LLIF patients were matched by age and gender to patients undergoing posterior only fusion for adult degenerative scoliosis. Mean posterior level fused was 10.3 ± 3.4 for cases, and 7.4 ± 5.2 for controls (p=0.013). Measurements were performed by two observers for pre- and postoperative sagittal vertical alignment (SVA) and lumber lordosis with satisfactory reliability concordance correlation coefficient (*Pc)* 0.4 to 0.9.

RESULTS: Preoperative sagittal balance and lumbar lordosis were similar in two cohorts (p=0.43, 0.96, respectively). For the 33 patients undergoing spinal deformity correction utilizing the LLIF technique, sagittal balance was improved, with the SVA significantly decreasing by a mean 13 ± 40 mm (p=0.038). There were four patients (12.1%) where positive sagittal balance shifted from >4 cm to <4 cm. In comparison, there was no mean change in SVA for controls (1 ± 46 mm, p=0.54). The mean lumbar lordosis significantly improved by 6º ± 16º (p= 0.047) in the LLIF cohort which was statistically different from the matching controls (p=0.036) that showed a minimally changed by (- 2º ± 12º, p=0.45). Over LLIF levels in cases cohort, the lumbar lordosis was significantly improved by 9°±10° (p=0.0001) while no significant improvement (-0.8° ± 13.3°, p=0.76) at ALIF disc levels. The lordosis change was statistically different between LLIF levels compared to ALIF levels (p=0.03).

SUMMARY: This case-control study found improvement of SVA and lumbar lordosis with a combined ALIF/LLIF technique compared to posterior fusion only. LLIF grafts effectively restored lumbar lordosis over the fusion levels.

KNEE

21-AB Surgical Time Predicts Readmission for Non-Infectious Reasons After THA and TKA

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INTRODUCTION: Readmission after total hip arthroplasty (THA) or total knee arthroplasty (TKA) places a large burden on the health care system, and understanding common drivers and predictors for readmission is becoming increasingly important. Surgical time has been shown to associate with surgical site infections (SSIs); we hypothesized it may also be associated with readmissions.

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 30 and 90 days of discharge and recorded time in surgery for all patients. A multivariable logistic regression model with adjustments for age, gender, race, payer type, length of stay (LOS), and co-morbidities (CHF and CAD) was used to calculate the odds ratio (OR) of readmission given a surgical time greater than or equal to two hours. Statistical significance was defined as $p<0.05$. We excluded patients with incomplete records of surgical time and risk factors, leaving 5,397 of the 6,631 patients who underwent THA or TKA during the study period for analysis. We further evaluated those readmitted with long surgical times, segmenting the readmitted population with available 90-day readmission code data into two groups: those readmitted with infection (ICD-9 codes 996.66 and 998.XX excluding 998.0, 998.4, 998.6, and 998.7; n=72) and those readmitted for non-infectious reasons (n=284). These groups were both compared to non-readmitted controls (n=5041).

RESULTS: Patients with surgical times of two hours or greater had an adjusted OR of 1.42 (95% CI: 1.08-1.87) for readmission within 30 days and of 1.26 (95% CI: 1.01-1.57) for readmission within 90 days. Patients with surgical times of two hours or greater had an adjusted OR of 1.02 (95% CI: 0.63-1.64) for 90-day readmission for infection and of 1.30 (95% CI: 1.02-1.66) for 90-day readmission for non-infectious reasons.

CONCLUSION: A surgical time greater than or equal to two hours was an independent predictor of readmission within 90 days; however, this was not due to an increased rate of infection.

22-AB Flexion Instability Following Primary TKA: Long-Term Results of 96 Patients Requiring Revision Over a 30-Year Period

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INTRODUCTION: Flexion instability is a well-documented cause of failure in total knee arthroplasty (TKA), and treatment often requires revision surgery. It is typically diagnosed by a subjective sensation of instability, recurrent knee effusions, significant anterior knee pain, and increased laxity with the knee in 90º of flexion.

METHODS: A retrospective review of all cases of revision total knee arthroplasty performed at our institution between 1970 and 2000 was conducted utilizing our institution's joint registry. A total of 1,876 cases were located. A total of 94 cases met the inclusion criteria of revision TKA for flexion instability with a minimum two-year follow-up and were included in the study. Primary revisions included: 75 total knee revisions, 10 isolated component revision, and 9 poly exchanges. The revision rate, reason for revision, and associated complications were determined.

RESULTS: TKA revision for flexion instability constituted 6% of all first time TKA revisions performed during the study period. Sixty-two patients were female and 32 were male with an average age of 68 years (range 35-89). Average follow-up was 9.2 years (range 2–24). Following revision, persistent instability was present in 13 patients and 1 experienced patellar dislocations. Deep infections occurred in 3 patients. Eighteen patients (19%) underwent a total of 19 additional TKA revisions after their index revision. Additional procedures performed included: 7 manipulations in 5 patients for stiffness, 2 extensor mechanism repairs, and 1 arthroscopic debridement for patellar clunk. Five patients continued to have flexion instability, but did not have re-revision surgery.

CONCLUSION: Flexion instability is an uncommon cause of revision TKA surgery. However, patients that are revised secondary to flexion instability have a high re-revision rate and approximately 24% may have persistent instability. In this population of patients, the historically more common causes of revision (infection, osteolysis, etc.) are less prevalent than continued symptoms of instability as a cause for re-revision. This study stresses the importance of proper gap balancing during the index surgery to prevent flexion instability.

23-AB Difference Between Postoperative and Preoperative Hemoglobin After THA and TKA Predicts Readmission within 90 Days

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INTRODUCTION: Readmission after total hip arthroplasty (THA) or total knee arthroplasty (TKA) places a large burden on the health care system, and understanding common drivers and predictors for readmission is becoming increasingly important. Preoperative (preop) and postoperative (postop) hemoglobin (Hb) concentration and the difference between the two (ΔHb), a proxy for blood loss, are practical measurements that may predict readmission.

METHODS: We retrospectively queried an electronic database for all patients who underwent THA or TKA at our institution from 2006 through 2010. For postop analysis, we restricted our study to patients with postop Hb values (n=5408); for preop analysis, we restricted to those with preop Hb values (n=610). ΔHb was calculated by subtracting preop Hb from postop Hb in the 610 patients who had preop Hb concentrations. Anemic patients were classified as such by using Hb cut-offs of <12 g/dl for females and <13 g/dl for males. We identified those who were readmitted within 90 days of discharge. A multivariable logistic regression model with adjustments for age, gender, race, procedure (TKR or THR), payer type, length of stay (LOS), co-morbidities (CHF and CAD), and surgical time was used to calculate the odds ratio (OR) of 90-day readmission. Statistical significance was defined as $p<0.05$.

RESULTS: Of 610 patients with preop Hb concentrations, there were 221 patients (36.2%) with preop anemia. Of the 5,408 patients with postop Hb concentrations, there were 4,683 patients (86.6%) with postop anemia. A 1.0 g/dl increase in ΔHb (1.0 g/dl loss in Hb) was associated with an adjusted OR of 1.31 (95% CI: 1.03-1.67) for readmission within 90 days. Neither preop or postop anemia nor preop or postop Hb concentration predicted readmission within 90 days.

CONCLUSION: A loss of Hb after TKA or THA predicted readmission within 90 days, while the preop or postop Hb concentrations alone were not predictive. This suggests that collecting both preop and postop Hb concentrations and calculating the difference between them may be helpful in predicting and preventing readmission after TKA or THA.

24-AB Complications in Conventional vs. Computer-Assisted Navigation in Sequential Bilateral Total Knee Arthroplasty

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INTRODUCTION: Risks and benefits of bilateral total knee arthroplasty (TKA), whether simultaneous, sequential single-staged, or staged is a topic of debate. Similarly, computer-assisted navigation for TKA is controversial regarding complications, cost-effectiveness, and benefits over conventional TKA. To our knowledge, no studies have compared computer-assisted and conventional techniques for sequential bilateral TKA. We hypothesize that the computer-assisted technique has fewer complications.

METHODS: We retrospectively reviewed 40 computer-assisted and 36 conventional bilateral sequential TKAs from 2007-2011 with one year follow-up for complications. Groups were matched by age, gender, body mass index (BMI), Charlson Comorbidity Index (CCI), and American Society of Anesthesiologists Classification (ASA). Pearson's chi-square, Fisher's exact test, and independent samples t-test were used to compare groups.

RESULTS: Our populations' mean age was 65.9 years, BMI 31.6, CCI 3.4, ASA 2.3, and a male to female ratio of 1:2. Computer-assisted demonstrated significantly better postoperative day (POD) 1 hemoglobin (p=.001), decreased number of blood transfusions (p=.001), and fewer complications (p=.023). Mean preoperative hemoglobin (Hgb) for both groups was 12.4 g/dL, but mean POD1 Hgb was 10.2 g/dL and 9.3 g/dL, for computer-assisted and conventional groups respectively. Total blood transfusion units were a mean of 1.0 and 1.7 for computer-assisted and conventional groups respectively. Seven (19%) patients in the conventional group had lethargy, altered mental status (AMS), or syncope versus none in the computer-assisted group. Subsequent Hgb levels, tourniquet time, length of stay, readmissions, and reoperations were not significantly different with numbers available between the two groups.

CONCLUSION: Computer-assisted sequential bilateral TKAs had higher Hgb on POD1 and lower blood transfusions and complications. This may be due to violation of the femoral canal causing increased bleeding using the conventional technique. Fat emboli from the femur may have caused AMS, but did not increase incidence of pulmonary embolism in the conventional group.

25-AB Analysis of Coronal Alignment After Total Knee Arthroplasty Using Patient Specific Cutting Blocks

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INTRODUCTION: The purpose of this study is to compare the postoperative coronal alignment after total knee arthroplasty (TKA) using patient specific cutting blocks with those performed by conventional TKA technique.

METHODS: The coronal alignment of 26 patients who underwent TKA utilizing patient specific cutting blocks was compared to a group of 27 patients who received a TKA via conventional technique. All surgeries were performed sequentially by a single surgeon. The mechanical axis of each patient was analyzed by three physicians on stitched, long-leg, standing radiographs. Cohen's kappa coefficient was utilized to assess interobserver agreement. Student's t-test was used to analyze the coronal alignment data.

RESULTS: There was no significant difference noted in the mean postoperative coronal alignment between the patient specific and conventional groups. Both groups had an overall mean of 180.4º. However, 42.3% (11/26) of the patient specific group was found to have greater than 3º of deviation from neutral mechanical axis, compared to 29.6% (8/27) of the conventional group, resulting in a significant difference ($p=0.031$). Average operative time was also significantly increased to 117 minutes in the patient specific group from 102 minutes in the conventional group ($p=0.0006$). The overall kappa coefficient of 0.899 demonstrates excellent interobserver agreement.

CONCLUSION: This study demonstrates a significant increase in the number of patients with greater than 3º of deviation from neutral mechanical axis in TKAs performed with a patient specific cutting block when compared to conventional technique. The patient specific cutting block technique for total knee arthroplasty should be approached with caution.

26-A Young Total Knee Arthroplasty Patients: Are They Really Active?

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INTRODUCTION: Total knee arthroplasty (TKA) utilization is projected to increase among younger patients over the next two decades. Demographic characteristics of this patient group may influence surgical technique and will likely impact TKA performance and survivorship. While patients younger than 55 years of age at the time of TKA are presumed to be more active, this patient group has not been well-characterized. The purpose of this study is to define the clinical features and activity levels of young patients undergoing TKA.

METHODS: We performed this retrospective analysis of 480 consecutive TKA procedures performed for patients less than 55 years of age over a 15-year interval. Age, gender, body mass index, and UCLA activity scores were reviewed. Statistical analysis was accomplished using 2-tailed student's t-test for continuous variables and chi-square or Fisher's exact test for categorical variables.

RESULTS: The majority of patients (69%) were female with a racial distribution reflecting regional population demographics (77% Caucasian, 22% African American, 1% other minority). Osteoarthritis (OA) was the most common indication for TKA (85.6%) followed by inflammatory arthropathy (6.5%) and osteonecrosis (4.6%). While mean UCLA activity was 5.3 for patients less than 40 years of age, it was below 3.6 for all five-year age increments older than 40. Only 6% of young patients reported being highly active, 11% were moderately active, 38% were mildly active, and 36% were sedentary. Average BMI was 34.3. Nine percent of patients with OA had a normal BMI, 19% were overweight, 45% were obese, and 26% were morbidly obese. Caucasian male patients had a lower mean BMI (30.85, $p=0.005$) and higher UCLA score (4.7, $p<0.001$) than other race and gender combinations.

CONCLUSION: The majority of younger patients undergoing total knee replacement surgery are female. Obesity and low activity levels are common characteristics of this population. These data are important relative to implant selection and expectations for surgery in the young TKA population. The survivorship of total knee arthroplasty among this patient group may be influenced by patient specific factors as much as by implant design considerations.

26-B Intermediate Follow-Up of the Mobile-Bearing TC III Revision Total Knee Arthroplasty

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PURPOSE: To evaluate the survival and functional outcomes in the rotating-bearing TCIII total knee arthroplasty (TKA) used in revision surgery.

METHODS: We performed a retrospective review of patients who underwent a revision TKA with a mobile-bearing TC III implant at our institution from 2000 through 2007. We excluded patients with <24 months of follow-up. Our primary outcome was failure rate as determined by revision surgery. Secondary outcomes included range of motion (ROM), pain, complications, and Knee Society Scores (KSS).

RESULTS: There were 26 patients included in the study with an average follow-up of 42 months (26–65). There were 13 men and 13 women with an average age at surgery of 67 years (48–88). Indications for initial surgeries were infection in 9 knees and aseptic loosening or pain in 17 knees. The average ROM preoperatively was 91^{o} (+/- 22), improving to 95^{o} post-operatively (+/- 21) (p =0.51). Preoperatively, the average KSS was 53 (+/- 19), and the functional score was 53 (+/-17). While the KSS improved to 80 (+/- 17) postoperatively (p<0.001), the functional score remained unchanged at 54 (+/- 27) (p=0.87). Twenty-four (92%) reported their preoperative pain levels as moderate or severe, decreasing to 8 (30%) postoperatively (p<0.001). There was one revision performed for aseptic femoral component loosening at 48 months, for a 96% total survival. There were four postoperative complications in addition to the revision, including two possible infections, one flexion contracture requiring manipulation, and one radiographic lucency around the components. A preoperative ROM >90^{o} significantly improved the postoperative KSS (p=0.02), functional Knee Society Score (p<0.05), and postoperative pain levels (p<0.05). It also decreased the number of complications (p=0.003) and increased the probability of a postoperative ROM >90^{o} (p=0.008). Of interest, preoperative infection did not significantly influence postoperative outcome measures.

CONCLUSION: A mobile-bearing TC III knee used in revision knee arthroplasty has good survival in the intermediate time period. An important factor predicting postoperative outcomes is a limited knee ROM preoperatively.

27-A MRI Analysis of the Extensor Mechanism in Patients Who Do and Do Not Exhibit Patellar Instability

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BACKGROUND: Previous study and reconstruction of the knee in chronic patellar dislocators has focused on the trochlear groove and alignment of the patellar tendon, neglecting the active forces within the knee. Despite being the attachment of the extensor mechanism, few procedures or studies address the orientation and role of the quadriceps tendon in these patients. It is hypothesized that the quadriceps tendon is further lateral and meets the patella at a more oblique angle in patients who experience patellar instability.

METHODS: Thirteen patients being treated for patellar instability underwent preoperative MRI. The patellar tendon, patella, quadriceps tendon, femur, and tibia were traced using the computer system BRAINS2 to create a 3D image. The angle between the quadriceps tendon and femur, between the patellar tendon and the tibia, and the lateral angle created by the patellar and quadriceps tendons were measured. These patients were age- and sex-matched to patients without patellar instability for 13 study knees and 13 control knees.

RESULTS: Averages showed differences between the two groups. The angle between the patellar tendon and tibia was 10.295 ± 4.36 lateral in the study group and 8.12 ± 2.13 lateral in the control group. The measurement between the quadriceps tendon and the femur was 5.575 ± 2.83 lateral in the study group and .45 ± 3.01 medial in the control group. The angle created by the quadriceps and patellar tendons was 164.13 ± 5.09 degrees in study patients and 172.33 ± 2.22 degrees in control patients.

CONCLUSION: Anatomic differences in the form of increased lateral angle of the quadriceps tendon in relation to the femur, lateral angle of the patellar tendon in relation to the tibia, and decreased lateral angle created by the patellar and quadriceps tendons are seen between chronic patellar dislocators and controls. The lateralization of these tendons may provide a risk factor for developing symptomatic patellofemoral instability.

27-B Successful and Unsatisfactory Outcomes of Manipulation Following Total Knee Arthroplasty

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INTRODUCTION: Patients can experience stiffness following total knee arthroplasty (TKA). These patients experience improvements in range of motion (ROM) following manipulation, however, may still have residual stiffness adversely affecting activities of daily living. This investigation identified prognostic factors predictive of patient's obtaining a satisfactory outcome of 90° or greater final ROM as opposed to an unsatisfactory outcome of less than 90° final 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 manipulation after TKA. Patients were separated into two groups based on final ROM or ROM at most recent follow-up: patients with a successful outcome defined as 90° or greater final ROM (n=89) and patients with an unsatisfactory outcome defined as <90° final ROM (n=30).

RESULTS: Preoperative ROM and intra-MUA ROM were lower in the unsatisfactory outcome group ($p=0.002$ and $p=0.03$, respectively). Caucasians had higher probability of successful outcome than non-Caucasians ($p=0.002$). Diabetes mellitus predisposed patients to unsatisfactory outcomes ($p=0.04$). No difference was observed in patients who had hyperlipidemia or hypertension ($p=0.18$ and $p=0.13$, respectively). The proportion of posterior stabilized (PS) and cruciate retaining (CR) implants was not different ($p=0.08$ and $p=0.17$, respectively). Also, no difference was observed in the rate of lateral release ($p=0.37$). Furthermore, patients who underwent simultaneous bilateral TKAs experienced a significant correlation between final ROM in both knees ($r=0.68$, $p=0.003$).

CONCLUSION: Non-Caucasian race and diabetes mellitus are significant predictors of final ROM arc less than 90° (all $p<0.05$). Furthermore, preoperative ROM, pre-manipulation ROM, and intraoperative ROM during MUA were significantly lower among the knees with less than 90° after MUA versus those with a successful manipulation (all $p<0.05$). When performing simultaneous bilateral TKAs, patients experienced similar final ROM in both knees.

28-A Survival and Clinical Outcome of Isolated High Tibial Osteotomy and Biological Knee Reconstruction

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BACKGROUND: Medial knee arthrosis with varus malalignment is a common cause of knee pain. Realigning, valgus-producing high tibial osteotomy (HTO) unloads the affected compartment and aims to relieve pain and improve function.

OBJECTIVES: (1) To determine survival and clinical outcome of HTO with or without articular cartilage surgery and/or meniscal allograft transplantation in patients with medial compartment chondral pathology, varus malalignment, and/or meniscal deficiency, and (2) to determine if there is any difference in survival or clinical outcome between opening- and closing-wedge HTO in this patient cohort.

METHODS: A systematic review was performed. Survival and clinical outcomes of isolated HTO, HTO with articular cartilage surgery (ACI, OATS, osteochondral allograft, and marrow-stimulation), and HTO with meniscal transplantation were recorded and compared. Further, opening- and closing-wedge osteotomy techniques were compared.

RESULTS: Sixty-nine studies (4,557 subjects) were included and analyzed. Survival of isolated HTO was 92.4%, 84.5%, 77.3%, and 72.3% at 5, 10, 15, and 20 years follow-up. At five years follow-up, HTO with articular cartilage surgery had significantly greater survival (97.7%) than either isolated HTO (92.4%) or HTO with MAT (90.9%). Isolated HTO, HTO with articular cartilage surgery, and HTO with MAT all significantly improved both subjective and objective clinical outcome scores. At two years follow-up, survival was significantly greater following OWHTO (98.7%) versus CWHTO (96.7%). However, there was no significant survival difference between the two techniques at any other time points.

CONCLUSIONS: Survival of isolated HTO is excellent at short- and mid-term follow-up, but deteriorates with time. The addition of articular cartilage surgery to HTO had significantly greater survival (97.7%) than either isolated HTO (92.4%) or HTO with MAT (90.9%) at five years postoperatively. All three cohorts (isolated and combined HTO techniques) significantly improved both subjective and objective clinical outcome scores. At two years follow-up, survival was significantly greater following OWHTO (98.7%) versus CWHTO (96.7%).

28-B Correlation of Aspiration Results with the Etiology of Aseptic Failure in Total Knee Arthroplasty

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SUMMARY: Aspiration results and etiology of failure were correlated in patients undergoing revision TKA, revealing monocyte count >13% and segmented cell count <28% to be 94% sensitive for aseptic loosening.

INTRODUCTION: In the evaluation of patients who have undergone total knee arthroplasty and subsequently develop knee pain, establishing an accurate diagnosis is paramount to the selection of a successful treatment regimen. It is unknown whether inflammatory markers and synovial analysis might differentiate between noninfectious causes of knee pain such as aseptic loosening, polyethylene wear, joint instability, and arthrofibrosis. A physiological basis exists to suggest that aseptic loosening might be a process of monocytic leukocytes. The objective of this study was to determine if arthrocentesis differential cell count might aid in the diagnosis of aseptic loosening in patients undergoing revision total knee arthroplasty

MATERIALS AND METHODS: The charts of all patients who had undergone revision total knee arthroplasty by either of the two senior authors (BRL and SMS) were reviewed. All patients with preoperative aspiration results were included. Data collected included characteristics of the synovial aspirate and operative report. Aseptic loosening was defined as gross intraoperative movement in the absence of infection. From these results, Mann-Whitney U tests were performed, Relative-Operating Characteristic (ROC) curves were created, and sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated.

RESULTS: 146 patients met our inclusion criteria, 47 of whom were classified as having aseptic loosening. A significant difference in differential monocyte cell percentage (mean±standard deviation: 12.5 ± 14.7 vs. 25.8 ± 26.9, p=0.003) and segmented cell percentage (45.6 ± 27.8 vs. 34.8 ± 27.8, p=0.038) existed between aseptically loose and well-fixed implants. When those implants with a monocyte cell percentage of greater than or equal to 13% were considered to be loose (which maximized the area under the ROC curve at 0.64), this test had a sensitivity of 77.6%, a specificity of 30.4%, a PPV of 49%, and a NPV of 60.7%. When those implants with a segmented cell percentage of less than or equal to 28% were considered to be loose (which maximized the area under the ROC curve at 0.48), this test had a sensitivity of 85.7%, a specificity of 35.7%, a PPV of 53.8%, and a NPV of 74.1%. When these tests were combined, i.e., that any implant with a differential segmented cell count percentage of less than 28% or a differential monocyte cell count percentage of greater than 13% was considered to be loose, diagnostic accuracy further improved to a sensitivity of 93.8%, a specificity of 51.8%, a PPV of 63%, and a NPV of 90.6%.

CONCLUSIONS: In patients with painful total knee arthroplasties in whom infection has been excluded, aspiration data can be a useful adjunct in the diagnosis of aseptic loosening. In aspirates with either a segmented cell count of less than 28% or a monocyte cell count of greater than 13%, the surgeon should consider aseptic loosening, if neither are found the likelihood of aseptic loosening is less than 9.4%. While non-specific, aspirate differential can be useful to “rule-out” aseptic loosening with a sensitivity well exceeding that of radiographs and paralleling that of bone scintigraphy. Synovial analysis could be considered in patients suspected to have aseptic loosening.

29-A Tibial Plateau Coverage in UKA: A Comparison of Patient Specific and Standard Implants

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INTRODUCTION: Tibial component fit, specifically significant overhang of the tibial plateau or underhang of cortical bone, can lead to issues including pain, loosening, and subsidence. The purpose was to utilize morphometric data to compare size match and fit between patient specific implants and incrementally sized standard unicompartmental knee arthroplasty (UKA) implants.

METHODS: CT images of 20 knees undergoing medial UKA were prospectively obtained. Standard implants and patient-specific implants were modeled in CAD, utilizing sizing templates for the standard and CAD designs for the patient-specific. Virtual surgery was performed, maximizing coverage of tibial plateau while minimizing implant overhang, and coverage of each implant on the tibia plateau was evaluated to examine fit.

RESULTS: Patient specific implants provided significantly greater cortical rim surface area coverage (defined as a continuous area 1.5 mm from the edge of the resected tibial plateau) versus incrementally sized standard implants, 77% vs. 44% respectively, ($p<0.0001$). The arc length of the patient-specific and standard implants was evaluated to determine the percent of implant edge resting on cortical bone 90% vs. 51%, ($p<0.0001$). A significant difference in the amount of overhang and underhang of the cortical rim area with patient-specific and standard implants was also observed; 0.24 mm vs. 0.52 mm maximum overhang, ($p=0.010$); 0.87 mm vs. 2.84 mm maximum underhang, ($p<0.0001$).

CONCLUSIONS: The variability of tibia plateau anatomy results in difficulty optimizing coverage and preventing significant implant overhang or underhang with standard unicompartmental implants. Previous studies have demonstrated significant clinical issues with pain, subsidence, and loosening due to overhang and underhang in standard implants. The study demonstrates that the patient-specific implants provide superior cortical bone coverage and fit while minimizing the inherent issues of overhang and underhang seen in standard implants.

29-B Obstacles to Early Mobilization After Total Joint Arthroplasty and Effect On Hospital Length of Stay

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INTRODUCTION: Recovery after total joint arthroplasty (TJA) continues to be refined through better multidisciplinary care. Various rapid recovery protocols exist, all which incorporate early postoperative mobilization. Mobilizing patients on the day of surgery is thought to improve function and range of motion, reduce the risk of postoperative venous thromboembolism, and reduce hospital length of stay (LOS).

METHODS: All patients undergoing primary or revision TJA between July 2009 and June 2011 within a four-hospital health system were retrospectively reviewed. Patients evaluated by physical therapy (PT) the day of surgery were included in the study analysis. Ambulation was attempted the day of surgery with PT, with or without the use of assistive devices. Distance ambulated, obstacles impeding ambulating 30 feet, and LOS were recorded. If a distance of at least 30 feet was not reached, a questionnaire indicating the reason(s) was completed. Patients reaching the in-patient unit after 1,500 hours were excluded.

RESULTS: Seventy percent of patients (3,878/5,525) successfully ambulated at least 30 feet. 117 patients were not evaluated secondary to personnel-related factors. A total of 1,530 patients ambulated under 30 feet, citing dizziness 47.6% (728/1,530), nausea 39.3% (601/1,530), drowsiness (15%), fatigue (11.5%), pain (10%), and poor muscle control secondary to femoral nerve block (7.3%) as limiting reasons. The average LOS of patients ambulating at least 30 feet the day of surgery was 2.03 days versus 2.68 days in those ambulating less ($p<0.05$).

CONCLUSION: The benefits of immediate postoperative mobilization are well elucidated in the literature, and this study highlights major obstacles limiting early ambulation after TJA. Focusing continued multidisciplinary efforts towards such factors as postoperative hypotension, nausea, drowsiness, and pain after TJA may further improve our development of rapid recovery programs. Furthermore, ambulating a distance of at least 30 feet the day of surgery correlates with a statistically significant shorter LOS.

30-A Complications of Oxford Partial Knee Arthroplasty: A Review of 300 Cases by a Single Surgeon

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Oxford partial knee replacement has an excellent track record with reproducible results from multicenter studies. There have been some reports of higher complication and failure rates from studies in this country. The purpose of this study was to look at the complication rates on a series of 300 cases done by a single surgeon with a minimum follow-up of three years from 2006 to 2012.

There were two revisions; one for persistent pain, one for dislocated component with ACL damage. There were two cases of infection; one deep and one superficial. Two cases of polyethylene dislocation were seen. Fracture on the tibial side was seen in two cases which were managed conservatively with protected weightbearing for six weeks. Recurrent hemarthosis was seen in one patient which was also managed conservatively. One case of fracture of the femoral component was seen six weeks after surgery managed by revision of the femoral component to a bigger size. There were two cases of fatal PE within a week of surgery.

This study demonstrates a survivorship of 99.3% survivorship at three years with revision as an endpoint. Infection rates were less than 0.75%

In conclusion, Oxford partial knee arthroplasty can lead to a successful outcome with few complication rates. The issue of ideal VTE prophylaxis for partial knee replacement will need to be resolved.

31-A Posterior Femoral Condyle Radiolucency in Mobile Bearing Total Knee Arthroplasty

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INTRODUCTION: Mobile-bearing (MB) total knee arthroplasty (TKA) was designed to improve knee kinematics and wear from the modular Fixed-Bearing (FB) TKA. Our hypothesis is that more wear could be seen from abrasion of the highly conformed polyethylene curved insert on the posterior condylar bone-implant interface with high flexion as well as the potential from backside wear. This may lead to early femoral loosening as shown in the literature with high-flexion designs. This study was designed to evaluate whether MB TKA shows increased radiolucency compared to FB TKA and report short-term clinical outcomes.

METHODS: Lateral knee radiographs of FB TKA (n=243) and MB TKA (n=233) knees were reviewed six weeks and a minimum of one year postoperatively for evidence of radiolucency adjacent to the femoral component. These results were cross-referenced with range of motion (ROM) and Knee Society Scores (KSS) using statistical analysis.

RESULTS: The MB design showed an increased rate of posterior condyle radiolucency (15%) compared to the FB insert (4%) ($P<.0001$). Radiolucent-positive knees were significantly associated with lower overall KSS and trended toward worse pain scores ($p=0.06$). Radiolucency was not significantly associated with ROM. Of note, the patients in the fixed-bearing group were noted to be older (77 vs. 65 years) and with a lower BMI (29.7 vs. 32.1) at the time of surgery compared to the rotating platform group ($p<0.001$).

CONCLUSION: MB TKA is associated with a higher rate of posterior condyle radiolucency compared to FB TKA. Radiolucency was unrelated to knee ROM, but could be secondary to more debris generated from the added motion against the insert. It may also be reasonable to conclude that the decreased age of the mobile-bearing group in this study may lead to increased activity and, thus, increased wear in these knees. Knees with radiolucency had lower KSS and trended toward worse outcomes in relation to pain, which has not been previously shown in the literature.

31-B Perioperative Outcomes of Solid Organ Transplant Patients Following Total Knee Arthroplasty

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INTRODUCTION: Metabolic disorders and immunosuppressive regimens theoretically place solid organ transplant patients at higher risk for bone disease and postoperative complications. The purpose of this study was to use a national database to compare acute complications, in-hospital mortality, length of stay (LOS), and admission charges for total knee arthroplasty (TKA) patients with and without a history of solid organ transplant.

METHODS: Nationwide Inpatient Sample data (1998-2010) were analyzed. Primary TKA patients with a history of solid organ transplant (kidney, liver, heart, lung, pancreas) were isolated (n=5,245), and compared to a cohort of TKA patients with no history of any transplant (n=4,931,017). Multivariable regression was used to identify the effect of transplant history on outcomes.

RESULTS: Between 1998 and 2010, growth of TKA among patients with a history of solid organ transplant (+381.7%) was significantly more pronounced than growth of TKA among non-transplant peers (+196.9%) ($p<0.01$). The prevalence of a variety of comorbidities, such as renal failure, liver disease, uncomplicated diabetes, hypertension, and deficiency anemias, was significantly elevated among transplant TKA patients. Following TKA, status post transplant patients had a greater rate of 1+ surgical/medical care complication(s) (7.3% vs. 5.7%), longer mean LOS (4.2 days vs. 3.7 days), and more admission charges ($40,999 vs. $35,686) ($p<0.01$). There were no in-hospital deaths after TKA in the transplant population, compared to a 0.1% mortality rate (n=4,910) in the non-transplant group. After adjusting for patient/hospital characteristics and comorbidity, transplant history was associated with a greater likelihood of 1+ complication(s) (odds ratio, 1.20) ($p=0.13$), 0.46 days longer LOS ($p<0.01$), and $3,480 increased admission charges ($p<0.01$).

CONCLUSION: TKA among patients with a history of solid organ transplant is becoming more common. Accounting for confounders, transplant patients have a longer LOS and greater admission charges associated with their TKA. Rates of acute complications and in-hospital mortality are not significantly elevated among transplant TKA patients.

32-A Functional Outcomes of MPFL Reconstruction vs. Graft Tissue Placement

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INTRODUCTION: The medial patellofemoral ligament guides the patella into the trochlear groove during the first 30° of knee flexion. Incorrect graft placement during MPFL reconstruction may cause continued patellar apprehension, subluxation, and dislocation or pain, limited motion, and arthritis. Intraoperative fluoroscopy is a method by which surgeons determine graft placement during surgery.

METHODS: Forty-eight patients who underwent MPFL reconstruction were retrospectively analyzed for MFPL graft placement relative to anatomic placement. Postoperative radiographs were analyzed using the Schottle method. Patients were then analyzed pre- and post-operatively for patellar instability. Range of motion at two weeks, six weeks, and final follow-up was recorded to assess problems with knee flexion. WOMAC, KOOS, and IKDC scores were recorded pre- and postoperatively and statistically analyzed. Intraoperative fluoroscopy images of 18 patients were analyzed, and compared to postoperative radiographs. It is hypothesized that anatomic placement of MPFL graft is consistent with improved outcomes for MPFL reconstruction.

RESULTS: The MPFL was placed anatomically 50% of the time; these patients had the lowest incidence of patellar instability, greatest improvement in outcome scores, and best achievement of early range of motion. The 20% with placement furthest from anatomic had problems with achieving early range of motion. Intraoperative fluoroscopy measures produced values comparable to those of the radiographs.

CONCLUSIONS: Anatomical placement of the MPFL tunnel in the femur during MFPL reconstruction prevents recurrent patellar instability, improves statistical measures of knee function, and improves final knee range of motion. Intraoperative fluoroscopy provides an accurate means by which to determine tunnel placement during MPFL reconstruction operations.

32-B The Relationship Between Posterior Tibial Slope and ACL Deficiency at Time of TKA

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INTRODUCTION: Numerous studies have identified biomechanical risk factors related to non-contact ACL injuries including subtalar pronation, knee recurvatum, intercondylar notch width, poor neuromuscular control, and varus morphotype. An additional risk factor that may also be associated with non-contact ACL injuries is posterior tibial slope (PTS). The main objectives of this study were to determine if there was a difference in the PTS between patients who were ACL deficient and patients who had an intact ACL; and whether any differences existed between genders within each group in terms of their PTS angle.

MATERIALS AND METHODS: 537 TKAs (452 patients) were evaluated. 98 patients were ACL deficient. Standing full-leg-length anteroposterior and lateral radiographs were used to determine the mechanical axis angle, PTS, and the degree of femoral shaft bowing. We examined differences in both preoperative and postoperative PTS and femoral shaft bowing between two groups (ACL deficient versus ACL intact) and by gender within each group.

RESULTS: ANOVA showed significant differences in PTS between the ACL-deficient group and ACL-intact group. Subjects in the ACL-deficient group had significantly greater PTS angles (12.32° ± 5.116°) when compared with ACL-intact subjects (10.79° ± 4.523°). The ANOVA showed no significant differences in the postoperative PTS between the ACL-deficient group and the ACL-intact group.

DISCUSSION: At the time of TKA, a cohort of ACL deficient knees had an increased PTS on radiographic analysis compared to an ACL intact control group. Measurement after TKA corrected the tibial slope, with no significant difference between the two groups.

33-AB High Complication Rate After Revision of Failed Metal-on-Metal (MOM) Total Hip Arthroplasty

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BACKGROUND: A growing body of evidence suggests that metal-on-metal (MoM) total hip arthroplasties (THA) have higher rates of failure and subsequent revisions than other bearing surfaces. Adverse reactions to metal debris (ARMD) have been shown to be a primary source of failure; however, these cases alone do not account entirely for the increased rate. It is possible that ARMD could predispose the implant to other types of failure, such as infection, loosening, or dislocation. There is little data demonstrating why these patients fail and how they fare after their revision surgery. This study aims to review reasons of failure after primary MoM THA with particular attention to post-revision survivorship and reasons for subsequent revision.

MATERIALS AND METHODS: We identified 50 sequential patients (50 hips) that had a MoM THA revised at one institution.

RESULTS: The primary reasons for revision included: pain with loose components (38%), infection (26%), adverse reaction to metal debris (16%), periprosthetic fracture (8%), impingement (6%), dislocation (4%), and pain of unknown origin (2%). Patients were followed up for a mean of 33 months (range 24-81 months) post-revision. Survivorship free from further revision for any cause at 24 months was 94.0% and at final follow-up was 90.0%. Reoperation was required in five hips (10.0%), and the reason for all subsequent revisions was due to infection. These five patients had initially been revised for ARMD (N=2), infection (N=2), and dislocation (N=1). Harris Hip Scores improved from 44.5 pre-revision to 74.5 at final follow-up ($p<.0001$).

CONCLUSIONS: In this series, infection is a significantly compromising factor in the survivorship of primary MoM THA as well in the survivorship of revision implants. These rates of infection are well above published results of their metal-on-polyethylene counterparts and highlight the possibility of ARMD increasing the likelihood of failure secondary to infection.

Level of Evidence: Level IV**,** Therapeutic Study. See Guidelines for Authors for a complete description of levels of evidence.
Keywords: Metal-on-meta, complications, revision arthroplasty, total hip arthroplasty, infection

34-AB The Clinical Value of the Histopathological Interpretation of Arthroscopic Hip Shavings: What Do We Learn?

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INTRODUCTION: The volume of hip arthroscopy has seen a dramatic rise in the last decade given the evolving indications and patient driven desire for less-invasive surgical treatment options of hip pathology. Previous studies have examined the clinical value of the routine examination of the pathologic findings from retrieved specimens including arthroscopy. The purpose of our study was to examine the clinical value of the histopathologic interpretation of arthroscopic hip shavings which has not been determined to date. We hypothesized that this routine practice of pathology consultation was both expensive and ultimately would not affect patient care.

METHODS: Between January 2008 and December 2011, 570 consecutive hip arthroscopies in 534 patients were performed by two orthopedic surgeons (MDS, MDA) at a single institution. Three cases were excluded as no surgical specimen was collected for analysis. We retrospectively reviewed the preoperative and postoperative diagnoses, procedure performed, and pathology reports from these procedures to determine if the routine histopathologic interpretation of the arthroscopic shavings altered patient care. We then estimated the total cost in 2012 dollars of these analyses using 2012 Medicare reimbursement for Common Procedural Codes (CPT) 88304 (Level III Surgical pathology, gross and microscopic examination) and 88311 (Decalcification procedure).

RESULTS: There were 373 females and 197 males with a mean age of 44 (range 16-81) who underwent 570 hip arthroscopies. The primary intraoperative diagnoses were labral tear and femoroacetabular impingement. Three cases were excluded as no specimen was sent for analysis. In 3/567 (0.005%) cases, the histopathologic interpretation differed from the surgeon's intraoperative diagnosis. Pigmented villonodular synovitis (PVNS), focal chondroid metaplasia, and chondrocalcinosis were identified histologically in these cases. These patients were followed clinically postoperatively and one (chondroid metaplasia) went on to total hip replacement. No cases demonstrated neoplasia or acute inflammation. In 2012 dollars, the total cost for these 567 analyses was estimated at $70,475 for our institution.

CONCLUSION: The routine histopathologic analysis of arthroscopic hip specimens offers little clinical value, is costly, and mandatory regulations of such analysis should be re-examined so that histopathologic interpretation can be requested by the treating surgeon based on intraoperative findings.

35-AB MRI Lesion Size and Prednisone Use Predict Success After Simple Head Decompression and Injection of Autologous Bone Marrow Concentrate♦

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INTRODUCTION: Previous reports on the use of autologous bone marrow concentrate in patients with early stage osteonecrosis (ON) have been promising. The purpose of this study is to report the results of bone marrow concentrate for treatment of early stage ON and describe predictors of outcome.

MATERIALS AND METHODS: Twenty-seven patients (39 hips) with early stage (Steinberg one and two) and with at least two years of clinical follow-up were included. Eighteen patients were male and nine were female with an average age of 43 years (range 21-68). Thirty-five of 39 hips underwent a preoperative MRI scan. The angle of femoral head involvement was calculated by localizing the largest cross-section of involvement of ON on the MRI and drawing an angle with the apex at the center of the femoral head and including the entirety of the ON area. Patients were assessed clinically and radiographically at two months, six months, one year, and yearly thereafter.

RESULTS: The average follow-up was 35 months either at last clinic visit or total hip arthroplasty (THA) (range 24-59 months). There were no immediate complications related to the procedure itself. Nine hips (23%) progressed to THA. The average degree of head involvement based on preoperative MRI in failure group was 150.4 and for the successful group was 66.6 ($p<0.0001$). Eighteen of 39 hips that developed ON were related to active or past steroid use. No failures were seen in patients who were previously on steroids and discontinued them before treatment. Patients that remained on steroids were significantly more likely to proceed to THA ($p=0.001$), and all five patients that remained on steroids progressed to THA.

DISCUSSION: At short-term follow-up, simple hip decompression and re-injection of bone marrow concentrate into the necrotic lesion provides satisfactory results in patients with early stage ON. Smaller lesions and discontinuation of steroid therapy were significantly associated with a successful outcome. The procedure is simple, relatively reproducible, and has a very low complication rate.

36-AB A Retrospective Study of a Comprehensive Pain Protocol Using a Continuous Fascia Iliaca Compartment Block in Patients Treated for Hip Fractures

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OBJECTIVE: In the US, there are 350,000 hip fractures annually, with the incidence projected to exceed 650,000 by 2050. The use of a fascia iliaca compartment block (FICB) has been shown to be effective in controlling pain in both hip arthroplasty and hip fracture. This study investigated the effects of a continuous FICB (CFICB) placed preoperatively when combined with a comprehensive pain protocol.

METHODS: Consecutive patients at our institution with a hip fracture after April 2011 were offered a CFICB for pain control. The block was placed before surgery by an anesthesiologist and monitored by the pain service. Typically, the catheter was removed on postoperative day two. Pain scores, mental status changes, medications, demographics, co-morbidities, pre-hospitalization ambulatory status and living situation, length of stay, documented delirium, complications, disposition, and mortality were recorded. The CFICB group (n=186) was compared to a historical control cohort (n=182) of hip fracture patients admitted prior to the implementation of the CFICB protocol (January 2011). The independent samples t-test, chi-square test, and Fisher's exact test were used to evaluate the impact of the CFICB.

RESULTS: The two groups did not differ on age, gender, pre-hospital ambulatory status, pre-hospital living situation, or pain scores on admission. The experimental group had a lower mean pain score at day 0 (2.08 vs. 3.12, $p<0.001$), day 1 (2.18 vs. 2.90, $p=0.002$), and day 2 (2.16 vs. 2.70, $p=0.019$). The two groups did not differ on discharge location (community, rehabilitation, nursing facility) ($p=0.33$). A trend toward improved functional status was observed in that 67.2% of experimental patients were able to ambulate prior to discharge compared to 57.7% of controls ($p=0.06$). The two groups did not differ on amount of pain medication, incidence of delirium, hospital length of stay, complication rates, and mortality.

CONCLUSION: FICB is a safe adjunctive treatment modality in the management of patients with hip fractures. CFICB patients reported lower pain scores and possibly have improved functional status in the acute postoperative period.

37-AB Seven Day Abbreviated Two-Stage Exchange Arthroplasty for Periprosthetic Joint Infection: Two- to Six-Year Results

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BACKGROUND: Periprosthetic joint infection (PJI) after arthroplasty of the hip or knee can lead to disastrous outcomes. Currently, two-stage exchange arthroplasty remains the preferred surgical treatment for chronic PJI. However, the exact duration between stages, duration of antibiotic treatment, and route of antibiotic delivery is not well defined. We developed a novel two-stage exchange arthroplasty technique based on concepts of direct intra-articular infusion of antibiotic combined with intra-articular negative pressure wound therapy (NPWT) with an interval of seven days between implant removal and re-implantation.

METHODS: Seventy-three consecutive patients with chronic PJI of the hip or knee were treated using our abbreviated two-stage exchange arthroplasty. Seven patients were lost to follow-up. One patient died. Two had obvious visual signs of infection at the time of proposed re-implantation, and, therefore, received an antibiotic-loaded spacer rather than new components. There were 37 knee and 27 hip PJI in 36 males and 27 females. There was one incidence of bilateral PJI of the knees. In total, there were 64 joints in 63 patients. All patients were followed for a minimum of two years and a maximum of six.

RESULTS: Using revision for recurrent infection as endpoint, there were seven failures. The success rate of patients remaining free from recurrent PJI was 89.062%. Of the seven failures, six underwent further surgery. The seventh failure was deemed medically unfit to undergo further surgery and was treated with oral suppressive antibiotics. Further surgery included: traditional two-stage exchange arthroplasty (3), repeat abbreviated two-stage exchange arthroplasty (1), knee fusion (1), and above knee amputation (1). These patients are currently free of infection.

CONCLUSION: Our success rate of 89.062% in treating PJI with an abbreviated seven-day interval between stages has shown short- to mid-term results comparable to traditional two-stage methods treating PJI. Substantial advantages include reduced morbidity for patients, a much faster, easier re-implantation stage for the surgeon, and potential economic savings to hospitals, the healthcare system, and payers.

38-A Does Pain Chronicity in Patients with Symptomatic Acetabular Dysplasia Correlate with Intra-Articular Disease?

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INTRODUCTION: Bernese periacetabular osteotomy (PAO) has become a common treatment for symptomatic acetabular dysplasia (DDH). The purpose of this study was to analyze the association between duration of hip symptoms and intra-articular disease severity in patients with symptomatic acetabular dysplasia.

METHODS: We reviewed a multicenter prospective database of patients that underwent a PAO for symptomatic DDH. The chronicity of symptoms at presentation, intraoperative labral, acetabular, and femoral head/neck cartilage pathology were recorded prospectively according to the Beck classification. Statistical analyses were performed to determine differences in intra-articular disease findings relative to the chronicity of symptoms.

RESULTS: A total of 555 hips in 555 patients were analyzed. Pain was present less than 6 months in 4.6%, 6-12 months in 24.4%, and greater than 1 year in 71.5%. Hips with 6-12 months of pain had labral damage with degeneration at 26% compared to 46.8% with pain 12-36 months and 53.8% ≥5 years ($p<0.024$). Labral morphology was also significantly different ($p<0.005$) between ≤6 months (12.5% hypertrophic), 12-32 months (34.9% hypertrophic), and ≥60 months (56.9%). Hips with 6-12 months of pain had chondromalacia in 26.9%, 12-36 months of pain 27.9%, and ≥60 months of pain 56.9% ($p<0.001$). There was no significant difference in acetabular labral, articular cartilage, and head-neck junction abnormalities when analyzed with gender, age, BMI or activity level.

CONCLUSIONS: Chronicity of hip pain was significantly associated with the presence and severity of acetabular labral pathology and chondromalacia at the femoral head-neck junction. Hips ≤6 months to 32 months of symptoms had a significant association with labral degeneration, and those with symptoms ≥60 months had significant association with femoral head-neck chondromalacia. In patients being considered for PAO correction of acetabular dysplasia, prolonged symptoms are associated with an increased risk of labral tears and head neck junction chondromalacia. Acetabular labral repair and head-neck junction osteochondroplasty may be considered in these patients.

38-B Symptomatic Femoroacetabular Impingement: Are There Gender-Specific Disease Characteristics?

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INTRODUCTION: Femoroacetabular impingement (FAI) is increasingly recognized as a cause of hip pain in young adults. Cam-type FAI is commonly thought to occur more in males, with pincer-type FAI occurring more in females. Our experience suggests that this generalization may be inaccurate. The purpose of this study was to compare the clinical, radiographic, and intraoperative characteristics of symptomatic FAI to determine gender-specific differences in FAI presentation.

METHODS: We retrospectively identified consecutive cohorts of 50 male and 50 female patients treated for symptomatic FAI by a single surgeon. Established clinical and radiographic methods were used for disease characterization. Statistical analysis was performed to identify significant differences in clinical, radiographic, and intraoperative findings between males and females.

RESULTS: Statistical differences in age, BMI, and pain chronicity by gender were not detected. Modified Harris Hip scores and UCLA activity scores were lower in females ($p<0.005$ and $p<0.014$, respectively). Females were more likely to have lateral hip pain ($p<0.047$), anterior/groin pain, and more internal rotation in flexion than males ($p<0.001$). Only 58.0% of females had less than 20° of internal rotation in flexion compared to 86.0% of males ($p<0.002$). Males were more likely to have an elevated alpha angle ($p<0.002$), a decreased head-neck offset ($p<0.007$), and elevated alpha angles on the AP pelvis radiographs ($p<0.001$). A crossover sign greater than 10 mm from the acetabular sourcil ($p<0.001$) and acetabular articular cartilage cleavage or defects ($p<0.001$) were significantly more common in males. The distribution of labral lesions was not significantly different (82% vs. 80% detachment).

DISCUSSION: Significant differences in disease characteristics exist between males and females with FAI. Female patients have greater disability at presentation and are less active than males with FAI at presentation, despite less advanced acetabular cartilage pathology. Female patients generally had milder cam-type deformities and less acetabular retroversion than males.

39-A Results of Core Decompression for AVN of Femoral Head Using Expandable Reamer and Placement of Biologic "Filler"

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INTRODUCTION: Core decompression of the femoral head for pre-collapse avascular necrosis has a wide range of reported success, and many techniques are used.

HYPOTHESIS: We hypothesized that a system allowing for expandable decompression of the femoral head to better decompress and debride the necrotic bone accompanied by supplementation with calcium sulphate and calcium phosphate would lead to improved results.

MATERIALS AND METHODS: A retrospective review was performed to evaluate all patients receiving the new technique. Patients were evaluated for conversion to total hip replacement (a failure of the procedure).

RESULTS: Seven of 26 (27%) hips treated with this technique subsequently required total hip replacement. There were no complications associated with the core decompression procedure.

CONCLUSION: Nearly ¾ of patients treated with this technique responded to treatment without the need for subsequent hip replacement. Further study will help determine those patients more likely to have successful results from this treatment.

39-B Are Male Patients with Acetabular Dysplasia at Higher Risk for Secondary Femoroacetabular Impingement?

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INTRODUCTION: The Bernese periacetabular osteotomy (PAO) is an effective and well-described procedure for the treatment of symptomatic acetabular dysplasia. Outcome of PAO is favorable in most patients, but a cohort exists in whom acetabular redirection is complicated by secondary femoroacetabular impingement. The purpose of this study is to compare the clinical presentation, radiographic hip morphology, preoperative function, and intraoperative findings between male and female patients undergoing a PAO for symptomatic acetabular dysplasia.

METHODS: A retrospective review of 127 consecutive patients with a primary diagnosis of acetabular dysplasia treated with PAO was performed. Patients with prior arthroscopic or open surgery of the affected hip were excluded. Clinical data including patient demographics, physical examination, radiographic measurements, intraoperative findings, and patient-rated outcome scores were collected.

RESULTS: There were 90 females and 37 males. Mean age (26 years) and BMI (25 kg/m^2) were similar among sexes. While males had higher preoperative UCLA activity score ($p=0.038$), there was no significant difference in other preoperative outcome scores. Males had less hip range of motion compared to females including average flexion ($p=0.001$), internal rotation at 90° of flexion ($p=0.003$), and external rotation at 90° of flexion ($p=0.001$). Acetabular inclination was higher in males ($p=0.047$), and acetabular retroversion was more prevalent ($p=0.005$). Assessment of femoral morphology for CAM impingement revealed higher alpha angle in males, but the difference was not statistically significant ($p=0.128$). However, the incidence of an impingement trough, evident on intraoperative evaluation of the head-neck junction, was higher in male patients ($p=0.034$).

CONCLUSION AND DISCUSSION: Male patients with acetabular dysplasia have a higher incidence of clinical and radiographic signs consistent with concomitant FAI. Preoperative evaluation of acetabular dysplasia in males should include careful attention to factors associated with FAI as these hips may be at increased risk of secondary impingement after PAO correction.

40-A Young Total Hip Arthroplasty Patients: Are They Really Active?

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INTRODUCTION: Hip arthroplasty utilization is increasing among younger patients. While patients less than 50 years of age are presumed to be active, this patient group has not been well characterized. The purpose of this study was to define clinical features and activity levels of young patients undergoing total hip arthroplasty (THA) or hip resurfacing (SRA).

MATERIALS AND METHODS: We retrospectively reviewed 1,330 consecutive THA and SRA procedures. Age, gender, BMI, UCLA activity level, SF-12, WOMAC, and Harris Hip scores were reviewed. Statistical analysis was accomplished using two-tailed student's t-test, chi-square analysis, or Fisher's exact test.

RESULTS: 1,116 THA and 214 SRA procedures were accomplished. Fifteen percent of procedures were bilateral. Fifty-eight percent of patients were male. Mean BMI was 29.2. Mean UCLA activity level was 5.0. Osteoarthritis (56%) was the most common indication followed by osteonecrosis (245) and DDH (12%). Four percent of patients were underweight, 14% had a normal BMI, 38% were overweight, 37% were mildly or moderately obese, and 7% were morbidly obese. UCLA activity scores were higher among patients undergoing SRA (7.1, $p<0.0001$), and males with osteoarthritis (6.1, $p<0.001$). Males reported higher preoperative SF-12, WOMAC, and HHS with the lowest values noted among females with diagnoses other than OA. Differences influenced by race and gender were associated with a larger proportion of African American female patients with osteonecrosis (51.1%) and Caucasian female patients with DDH (26.3%).

CONCLUSION: Young patients undergoing THA fall into discrete subpopulations. Male patients are more likely to have osteoarthritis and to remain active prior to their elective arthroplasty. Female patients, on average, are younger and less active, reflecting a higher incidence of inflammatory arthropathy, DDH, and osteonecrosis associated with medical comorbidities. Given high activity levels among the most active patients, selective use of alternative bearing surfaces may remain a reasonable consideration, and close long-term implant surveillance will likely remain an important component of treatment.

40-B Do Surgeons and Third Party Payers Agree on the Criteria to Diagnose Femoroacetabular Impingement?

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INTRODUCTION: Femoroacetabular impingement (FAI) is characterized by abnormal, repetitive contact between the femoral head and the acetabular rim leading to articular cartilage delamination, labral tears, and secondary osteoarthritis. The criteria to diagnose FAI remains controversial. Disagreement between third party payer policies and the surgeon's clinical diagnoses can delay or prevent treatment. The purpose of this study was to compare the clinical diagnoses of FAI with third party payer policies to determine the level of agreement/ disagreement.

METHODS: A prospective, multi-center database of over 2,250 hip preservation procedures was searched to identify patients who underwent a hip preservation procedure for the treatment of FAI (1,130 hips). Three insurance companies' coverage policies with strict criteria for the surgical treatment of FAI were then applied to this patient population. These criteria included various combinations of symptom duration, age, positive impingement test, radiographic osteoarthritis, radiographic signs of cam and/or pincer impingement, and intraoperative Outerbridge classification.

RESULTS: 1,076 patients (1,130 hips) underwent FAI surgery. The patient demographics included 55% females, average age 28 years, and average BMI 26.5 kg/m^2. Acetabular and femoral head chondral disease was noted at the time of surgery in 82.8% and 24.0% of hips respectively. 94.8% of hips were noted to have labral disease. 98.3% of hips demonstrated labral and/or chondral disease. Application of the three different insurance policies to this group of patients resulted in 39%, 57%, and 81% of the patients being defined as having the appropriate criteria for surgical treatment of FAI. Exclusion of the intraoperative Outerbridge cutoff from the evaluation increased inclusion from 39% to 66% and 57% to 76%.

CONCLUSIONS: 19-61% of FAI diagnoses do not meet the current criteria of third party payers. These data indicate a major need for improved consensus in the diagnosis and surgical treatment of FAI.

41-A Short Stem Metaphyseal Engaging Implants: The Impact of Design on Contact Area and Positioning

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Short stem metaphyseal engaging implants in total hip arthroplasty (THA) aim to achieve an extensive circumferential fit within the proximal femur, increasing contact area and promoting long-term bone remodeling. Areas of contact depend upon proximal implant design parameters. The goal of this study was to compare the radiographic outcomes in patients who underwent THA with one of two uncemented short stem metaphyseal-engaging implants.

A review of prospectively collected data on 105 patients (average age 65 years/BMI 29 kg/m^2) who underwent a total of 109 primary THA using a ABG II implant, and 160 hips in 149 patients (average age 70 years/BMI 28 kg/m^2) using the Citation. There was no significant difference in demographics (age, gender, or BMI) or in preoperative WOMAC and Harris Hip Scores (HHS) between the two groups. Postoperative outcomes and alignment on radiographs were compared.

Postoperative HHS and WOMAC scores in the ABG II group were 90 and 10, respectively. There was no statistically significant difference when compared to HHS (94) and WOMAC (4) scores in the Citation group ($p>.1$).

Zero of the ABG II implants were found to be placed in varus (0%), while 8 of the Citation implants were placed in varus (5%).

Both implants provide great clinical and functional results in primary THA. The lateral flare on the Citation implant led to a greater number of implants in varus alignment, potentially affecting offset and leg-length. Optimal short stem metaphyseal engaging implants maximize contact area proximally while restoring hip kinematics.

41-B How Reliable Are Radiographic Parameters of Femoroacetabular Impingement?

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INTRODUCTION: Precise characterization of proximal femoral and acetabular morphology is fundamental to the diagnosis and treatment of femoroacetabular impingement (FAI). Manual measurements of radiographic parameters of FAI are time-consuming and have been shown to have limited reliability. We developed a computer software system for hip radiograph interpretation in an attempt to improve reliability. The purpose of this study was to determine the reliability of hip surgeons in determining radiographic indicators of FAI with this novel computer-assisted protocol.

METHODS: AP pelvis and 45º Dunn lateral radiographs from 70 consecutive patients undergoing hip preservation surgery were analyzed by four experienced surgeons with a computer-assisted protocol. Parameters of cam-type FAI included the alpha angle, head-neck offset ratio, and triangular index. Parameters for pincer FAI included crossover sign, posterior wall sign, prominent ischial spine sign, coxa profunda, lateral center edge angle, and acetabular inclination.

RESULTS: Parameters of cam-type FAI had variable levels of reliability. The head-neck offset ratio and triangular index distance had excellent interobserver reliability, with ICCs of 0.89 (0.85, 0.92) and 0.96 (0.94, 0.97), respectively. The alpha angle demonstrated fair overall reliability (ICC 0.43 [0.31, 0.56]). Classification of the alpha angle using commonly utilized cutoffs demonstrated fair reliability (Kappa 0.37-0.41). Parameters for pincer FAI demonstrated moderate-substantial interobserver reliability (Kappa 0.44-0.75). The most reliable parameters were posterior wall sign and prominent ischial spine sign (interobserver Kappa 0.73 and 0.75). The crossover sign was moderately reliable (Kappa 0.60 [0.55, 0.66]).

DISCUSSION AND CONCLUSION: Computer-assisted radiographic interpretation improves the reliability of hip radiograph analysis. The head-neck offset ratio and triangular index distance demonstrated excellent interobserver reliability, while the alpha angle had fair reliability. Parameters of pincer-type FAI generally had moderate-substantial levels of reliability. FAI parameters with excellent reliability should be considered for clinical care and research initiatives.

42-A Radiographic Comparison of Limb Length Discrepancies in Single-Stage vs. Two-Stage Bilateral Total Hip Arthroplasty

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INTRODUCTION: Osteoarthritis of the hip presents as bilateral disease in 42% of patients. Bilateral total hip arthroplasty (BTHA) performed under one anesthetic continues to gain acceptance, with literature support that single-stage BTHA in medically fit patients has an acceptable incidence of complications. In order to optimize function, a major goal of THA is to restore hip mechanics to as near normal as possible. Whether restoration of limb lengths is maximally achieved in single- versus two-stage BTHA is not fully understood. Our hypothesis is that performing BTHA under a single anesthetic produces optimal radiographic limb lengths in patients with bilateral pathology.

METHODS: We retrospectively reviewed 6 (or 12) week postoperative radiographs of 77 patients (154 hips) in the single-stage group and 28 patients (56 hips) in the two-stage group. In the two-stage group, radiographs were reviewed after the second procedure. The single-stage group had surgery performed on the same day under a single anesthetic and the two-stage group between six weeks and one year. Two blinded observers independently measured the preoperative and postoperative AP pelvis radiographs using digital imaging and measurement software. Limb length discrepancy (LLD) was measured from the inter-teardrop line to the most medially prominent aspect of the lesser trochanters. Offset comparison between operative sides were measured as the distance from the teardrop vertically to the ipsilateral lesser trochanter laterally (picture). A two tailed t-test was utilized for statistical analysis.

RESULTS: There was no difference in limb lengths preoperatively, with a mean LLD in the single-stage group of 3.91 mm (SD 3.92 mm) and in the two-stage group a mean of 4.37 mm (SD 3.43 mm) ($p=0.59$). Postoperatively, the single-stage group had a mean LLD of 3.70 mm (SD 3.59 mm), and the two-stage group had a mean LLD of 6.22 mm (SD 3.14 mm) ($p=0.002$). There was no difference in postoperative lateral offset between groups, with a single-stage mean difference of 5.25 mm (SD 5.8 mm) and two-stage difference of 4.53 mm (SD 3.62) ($p=0.45$).

CONCLUSION: The restoration of leg length is well known to affect patient satisfaction, and LLD continues to be a leading source of litigation. To our knowledge, this is the first report of a significant difference in LLD in patients that have had bilateral total hip arthroplasty performed in either a single- or two-stage procedure. It is likely that both intraoperative component selection and postoperative rehabilitation differences contribute to improved leg lengths in single-stage procedures. While the LLDs in our study fall within generally acceptable limits, it is unknown whether this translates into functional or true LLDs by patients.

42-B Is Unilateral Balance Symmetrical Following Total Joint Arthroplasty One Year Following Surgery?

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INTRODUCTION: Total joint replacement surgery is an effective way to alleviate painful osteoarthritis symptoms; however, it has been reported to not normalize loading asymmetries during the single leg stance phase of gait up to one year following surgery. Therefore, we wanted to examine if a fundamental difference existed in single leg stance ability in patients following total joint replacement.

METHODS: This study examined single leg balance in 234 total joint replacement patients (75 total hip arthroplasties [THA], 65 total knee arthroplasties [TKA], and 94 total ankle replacements [TAR]) 12 months following surgery with isolated unilateral involvement. The single leg balance assessment required patients to maintain unilateral balance for ten seconds on the surgical and non-surgical side with their eyes open. Statistical analysis was conducted using a chi-square to examine the pass:fail ratio across the different total joint surgeries. In patients who failed the test, a 2 x 3 (side x surgery) ANOVA was used to determine if bilateral differences in balance existed across surgeries ($\alpha=0.05$).

RESULTS: Patients one year following THA and TKA passed the single leg balance test at a similar rate (63% and 69%, respectively) while patients following a TAR exhibited a noticeably lower pass rate (9%). A significant interaction ($p<0.01$) existed for unilateral balance between the surgical and non-surgical legs across the different surgeries in patients who failed the balance screening test. Patients following THA and TKA exhibited less bilateral asymmetry than the TAR patients

DISCUSSION AND CONCLUSION: Patients following THA and TKA tend to exhibit better unilateral balance in comparison with TAR patients. It should be understood that the ten second cut score utilized in this study is significantly below the standard for age-matched controls (26.0 sec). The drastic decrease in single leg stance pass rate for the TAR patients could indicate the importance of the ankle in maintaining balance and may be an important function to normalize postoperatively. Future studies in this area may want to examine single leg balance as a clinically relevant screening tool for unilateral function.

43-A Cementless Acetabular Fixation without Bone Graft in High Grade Hip Dysplasia: Minimum 20-Year Follow-Up

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INTRODUCTION: Total hip replacement in patients with high grade hip dysplasia has classically been performed using superior lateral bone grafts, initially with cemented fixation of the acetabular component and later with cementless acetabular fixation. We evaluated the minimum 20-year results of THA performed consecutively by a single surgeon in patients with high grade dysplasia that were treated with a cementless acetabular component without superior lateral bone graft fixation.

METHODS: Eighteen consecutive hips in 14 patients with high grade hip dysplasia underwent THA using an HG-I acetabular component with screw augmented fixation and a cemented Iowa stem. The average age at the time of surgery was 50 years (range 38 to 77). All patients were female. 0 to 33% of the acetabular component was left uncovered supero-laterally. At a minimum of 20-year follow-up, patients were evaluated clinically for need of revision and on radiographs for loosening, osteolysis, and acetabular liner wear. Results were compared to the same surgeon's results of cemented THR in cases of hip dysplasia.

RESULTS: At minimum 20-year follow-up, 9 patients (12 hips) were living, and 5 patients (6 hips) were deceased. Average radiographic follow-up of the hips in living patients was 22.4 years (range 19.5 to 24). Eight hips required revision: 2 hips for femoral loosening, 5 hips for acetabular liner wear, and 1 hip for periprosthetic fracture. The average linear wear rate was 0.167 mm/year. No acetabular components were revised for loosening (compared to 12% of 66 cemented THRs performed for CDH by the same surgeon, difference $p<0.001$). No acetabular components were radiographically loose (compared to 28% in the cemented series, $p<0.005$).

DISCUSSION AND CONCLUSION: At minimum 20-year follow-up of THA using cementless acetabular components without bone grafts for high grade CDH, no hip demonstrated acetabular loosening. Results were superior to the senior author's experience with cemented acetabular fixation.

43-B Anterior Approach Total Hip Arthroplasty Using a Proximal Metaphyseal Bone Sparing Stem: Surgical Technique and Early Complications

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PURPOSE: The anterior approach to primary total hip arthroplasty (THA) using the Fitmore Hip Stem® is reviewed, with a specific focus on the operative technique, postoperative radiographic evaluation to determine component alignment, and any early complications.

METHODS: All primary THAs performed from 2007-2011 by a single surgeon were retrospectively analyzed. A total number of 108 cases were identified with the use of this stem and approach. The surgical technique with this stem and the anterior approach was outlined. Subsequently, chart review of these patients was performed to investigate early complications including intraoperative fractures, postoperative dislocations, and rates of infection. Finally, radiographs were reviewed to study component alignment. The mean age of all patients was 57.7 (±12.6). The mean follow-up was 12.9 (±9.1) months, and the mean length of stay was 3.6 (±0.9) days.

RESULTS: There were a total of 8 (7.4%) complications of which 2 (1.9%) required revision surgery. There was one revision for cup malalignment with recurrent dislocations. The other case involved a two-staged revision arthroplasty for a deep infection. In total, 3 (2.8%) cases of infection and 3 (2.8%) cases of dislocation were observed. Postoperative leg length inequality greater than 5 mm was seen in 3 (2.8%) cases. Radiographic analysis showed an average abduction angle of 44.8 (±5.3) and an average cup anteversion of 16.2 (±4.2).

CONCLUSION: While the radiographic results seem promising, the complication rates are similar to those encountered with other approaches. Although this study demonstrates good early clinical results using a bone preserving stem, long-term studies are required to evaluate the functional outcomes of this technique in the setting of primary THA.

44-A Revision Total Hip Arthroplasty Using Modular Tapered Stems

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Revision THAs have become increasingly frequent. Good clinical outcome has been reported with using modular tapered stem designs in femoral revisions. The purpose of this study is to evaluate the outcomes of a consecutive series of femoral revisions done using modular tapered stem designs.

For a six-year time period at a single institution, 111 consecutive revision THAs were performed by a senior surgeon using either the ZMR stem (n=68) or the Restoration modular stem (n=43). All patients were entered into a prospective database. We retrospectively reviewed the data including patient demographics, indication for the revision, the stem failure rate, and the complications. Stem failure was defined as implant removal for any reason.

The mean age was 62.7 years (34-85) with a BMI of 29.2 kg/m^2 (18.2-56.5). The most common reason for the revision was aseptic loosening (69.4%), followed by peri-prosthetic fractures (9.9%), and deep infection (9.0%). The mean follow-up was 37 months (12-97). The average Harris Hip Score increased from 52.5 to 92.3. Reoperation for any reason occurred in 27 cases (24.3%). The most common reason for reoperation after revision THA was dislocation (8.1%), followed by deep infection (5.4%), superficial infection (4.5%), and peri-prosthetic fracture (2.7%). Re-revision or removal of the stem was necessary in nine cases (8.1%). The most common reason for stem removal was deep infection (3.6%), followed by stem fracture (1.8%), and stem subsidence (1.8%). One stem had to be removed due to peri-prosthetic fracture (0.8%).

Femoral revision failure has been reported as high as 21% using proximally-coated uncemented stems, especially if there is significant femoral bone deficiency. Modular tapered designs allow rigid distal fixation, variable length, offset, and anteversion, as well as extensive inventory to address bone deficiency. Our aseptic stem failure rate is comparable to those reported using similar designs. Overall reoperation rate was high, but also comparable to other reports.

EDUCATION

44-B Podium Disclosures at the 2012 AAOS Meeting: An Exercise in Going Through the Motions

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PURPOSE: Disclosure prior to presentations in the form of a slide is the current accepted practice at most orthopedic meetings. These slides are often supplemented with a printed disclosure in meeting program guides. The fidelity and usefulness of this disclosure format have not been investigated. This study reports the practice of verbal disclosure during the 2012 AAOS meeting to determine if the process is accomplishing its primary goal in helping audiences critically gauge the data which is being presented.

METHODS: Orthopedic residents and fellows completed questionnaires related to the verbal and slide-based disclosures presented at paper symposiums and ICLs they attended at the AAOS meeting. The attendees were instructed to record the duration of time for which a disclosure slide remained visible to the audience. An attempt to count the words appearing on the disclosure slide or photograph the disclosure slide so that subsequent word count could be obtained was also performed.

RESULTS: 139 disclosures were observed during this study across a range of orthopedic subspecialties including adult reconstruction, hand and wrist, pediatrics, shoulder and elbow, sports medicine, trauma, and oncology. Of the 139, 125 (90%) included the required presentation slide and were considered for further analysis. Ninety-five slides had a number or words which were countable with an average 19.6 words per slide, while 30 slides were not presented long enough to permit an accurate word count or photograph. The average time that disclosure slides were available for viewing was 3.1 seconds. Only 52% of slides noted whether the authors disclosures were related to the data presented, and 60% of presenters failed to mention this fact verbally. Only 45% of studies with multiple authors included co-author disclosures on the slide. Institutional disclosures were absent from slides and discussion in 83% of presentations.

CONCLUSIONS: Ninety percent of presentations observed included disclosure slides. Despite the fact that these slides were shown, they were ineffective due to deficiencies in timing, format, and content. The practice of the required slide should be abandoned for a more direct, standardized, and objective practice of disclosure.

45-AB PGY-1 Orthopedic Surgery Residents: Rotation and Educational Experience During the Internship Year

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BACKGROUND: Little is known about the rotation content and education opportunities offered to PGY-1 orthopedic surgery residents. The purpose of this study was to survey residents and residency program directors to quantitatively and qualitatively evaluate rotations and exposure to orthopedic educational experiences during the intern year.

METHODS: An online survey was distributed to all program directors and recently promoted interns (now PGY-2s). Topics included program demographics, rotations, call, surgical case logs, conference and research participation, acquisition of orthopedic knowledge and surgical skills, and overall satisfaction with the internship experience. Results were compared between residents and program directors and also were sub-analyzed based on size of residency program.

RESULTS: Both residents and program directors reported adequate exposure to orthopedic surgery during the PGY-1 year, evidenced by 80% participation in the maximum three months of orthopedics, as well as conferences and research. Over 90% of residents were satisfied with their orthopedic surgery rotations; however, fewer residents were satisfied with the non-orthopedic surgery rotations (46%), as well the acquisition of orthopedic knowledge (58%) and surgical skills (44%). Fewer than half of all respondents indicated that the internship year was good preparation for the coming years of residency. Additionally, significant differences were found in experiences between residents in small and large programs: residents in smaller programs logged more cases and were more satisfied with their acquisition of orthopedic knowledge and surgical skills than those in larger programs.

CONCLUSIONS: While most residents and program directors are satisfied with the orthopedic surgery component of the intern year, half do not believe that it is good preparation for the coming years of residency. Half of residents are dissatisfied with their acquisition of orthopedic knowledge and surgical skills. More research is required to elucidate why significant differences in experience are occurring between residents in small and large programs.

46-AB Reliability of an Adaptive Computer-Based Patient Outcomes Scoring Tool in Orthopedic Trauma Patients

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INTRODUCTION: As patient outcomes drive surgical technique, reimbursement, and healthcare policy, a more efficient and reliable means of collecting patient-reported outcomes is required. Current paper-based forms can be unreliable with possible patient and investigator error, and responder burden if multiple forms are used. The purpose of the study was to determine the reliability of a computer-based condensed patient-centered outcome score system versus multiple standard uncondensed validated outcome scores used in orthopedic trauma.

METHODS: A commercially available web-based clinical research and EMR program (OBERD) was used to create a condensed version of the Musculoskeletal Functional Assessment (MFA), EQ-5D, MPI/PDI, and VAS. By using adaptive questioning, visual aids, and forced responses, this system populates each questionnaire in its entirety while decreasing responder burden. To determine reliability, patients seen at an orthopedic trauma outpatient clinic completed the computer-based questionnaire and the paper versions of the EQ-5D and MFA at different times to compare the actual scores.

RESULTS: One hundred patients completed both surveys. The average score difference between the computer-based and paper-based MFA was 0.5 with a standard deviation of 6.03 and a 95% confidence interval of -0.71-1.71. For the EQ-5D, the average score difference was 0.116 with a standard deviation of 0.2 and a 95% confidence interval of -0.0483 to 0.0483.

CONCLUSIONS: As patient-centered outcomes drive the direction of orthopedic care, collecting patient data efficiently while minimizing responder burden will be critical. This condensed web-based adaptive outcome tool reliably produced similar scores when compared to individual paper scores while decreasing responder burden and error.

47-AB Orthopedic Surgery Residency Application Process: Survey of Graduating Medical Students

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INTRODUCTION: There have been no reports of the specific qualities of Orthopedic Surgery residency programs that influence medical students involved in the match process. The purpose of this study was to survey graduating medical students involved in the Orthopedic Surgery residency application process regarding the factors which strongly influenced their opinions and ranking of training programs.

METHODS: An online survey was e-mailed to the 769 applicants to our institution's Orthopedic Surgery residency program for the 2012 NRMP match. Respondents were asked to quantify, on a scale of 1 to 10, the attributes of training programs which influenced their selection and ranking of programs when submitting their match list to the NRMP.

RESULTS: 213 surveys were completed (27.6% response rate); 81% were male and 19% were female with an average age of 27.2 years (range, 24 to 36). Thirty-one percent of applicants decided to pursue Orthopedic Surgery as a career prior to beginning medical school, and over half of respondents decided prior to their third year of medical school (52%). Operative experience, resident interaction during the interview, exposure to Level 1 trauma, and post-residency fellowship placement were cited as the most important attributes in selecting a residency training program. Gender and ethnic diversity and facility tours during the interview day were the least influential factors for the respondents.

DISCUSSION AND CONCLUSION: Our data identified operative experience as the most important factor for applicants when considering training programs, while gender and ethnic diversity were not identified as influential factors for applicants evaluating residency programs. The results of this survey may help administrators and residency program directors identify and improve the elements of their training programs that are important to the current generation of medical student applicants.

48-AB Surgical Telementoring: Augmented Reality in Orthopedic Education

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INTRODUCTION: Surgical telementoring is the use of technology to allow an expert surgeon at a remote location to mentor a second surgeon performing surgery. New technologies including virtual presence and augmented reality provide monitored yet meaningful surgical experience to surgeons undergoing training or learning new techniques, devices, or procedures. Virtual Interactive Presence (VIP) technology allows a proctoring surgeon to superimpose a hand or tool directly into the surgical field image. The purpose of this case series is to evaluate surgical telementoring using the VIP technology.

METHODS: A total of 15 patients receiving arthroscopic shoulder surgery at a Veterans Affairs (VA) hospital were enrolled in this IRB-approved study. Two VIP stations with an IP-based connection were utilized, with one positioned in the operating room and the other in the surgical dictation room. The attending surgeon proctored operating resident surgeons from the dictation room. Following each procedure, all surgical staff were administered questionnaires regarding system performance and safety. Residents and faculty were also evaluated regarding the education value of this technology. Surgical times and complications were recorded.

RESULTS: Attending and resident surgeon's questionnaires indicated the system increased resident autonomy, maintained sufficient oversight and safety, optimized communication, and increased the attending physician's effectiveness as a mentor. All surgical staff agreed that use of the technology did not pose an additional safety threat to the patient or procedure. Rotator cuff repairs and instability cases performed using the VIP system averaged similar operative times compared to those performed prior to its use, and no complications were experienced.

CONCLUSION: The use of the VIP technology was effective in allowing the attending surgeon to remotely proctor resident surgeons. Resident training was enhanced, as well as the attending surgeon's effectiveness as a proctor. This technology may be applicable to broader domains such as proctoring in rural areas, across borders, or by the military.

49-AB A Surgical Skills Simulation Training Program in an Articular Fracture Model for Orthopedic Junior Residents

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INTRODUCTION: Simulation of surgical skills is an increasingly important topic in orthopedics. We previously developed a three-segment articular fracture reduction simulator that discriminated senior residents from junior residents in regards to hand motion. The purpose of this study was to determine if a surgical skills training program could improve performance in junior residents using the articular fracture model.

METHODS: Six PGY1 and six PGY2 residents were randomized into an intervention (n=6) and control group (n=6). The simulation task was to stabilize a three-segment tibial plafond articular fracture using K-wires and fluoroscopy. All 12 residents performed the task twice, with the two sessions separated by four weeks. The intervention group underwent simulator training, which consisted of web-based modules, video critique by a traumatologist, and 1-2 hour practice on the simulator with traumatologist feedback. Performance was scored using validated subjective (Objective Structured Assessment of Technical Skills) and objective (articular step-off, hand motion) metrics. Radiation dose and fluoroscopy time were also captured.

RESULTS: The intervention group had a higher median OSATS score after simulator training compared to the control group ($p=0.03$). There was no significant difference in articular step-off or hand motion between the two groups. There was statistically significant less radiation dose ($p=0.03$) and less fluoroscopy time ($p=0.03$) in the intervention group after training.

CONCLUSION: This study shows that a surgical skills training program using a simulated articular fracture model has the potential to improve technical performance by junior surgeons with little to no articular reduction experience. The OSATS score, fluoroscopy time, and radiation dose were significantly improved in the intervention versus the control group. More subjects and training sessions are likely needed to demonstrate a statistically significant difference in articular reduction and hand motion.

* = 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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Chu, Alice	n
Cizik, Amy M.	6 – Synthes
Clark, Randy R.	n
Clay, Terry B.	n
Clayton, Matthew D.	n
Clohisy, John C.	3b – Biomet, Pivot Medical; 5 – Wright Medical Technology, Inc., Zimmer; 8 – Journal of Bone and Joint Surgery – American
Cofield, Robert H.	1 – DJ Orthopaedics, Smith & Nephew; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Cohen, Ariel	n
Colbrunn, Robb	n
Cole, Brian J.	1, 3b, 5 – Arthrex, Inc.; 1, 5 – DJ Orthopaedics; 1, 7, 8 – Elsevier ; 2 – Genzyme; 3b – Allosource, Biomimetic, Carticept; 3b, 5 – DePuy, a Johnson & Johnson Company, Zimmer; 5 – Johnson & Johnson, Regentis; 5, 7 – Smith & Nephew; 7 – Lippincott, WB Saunders; 8 – AAOS, American Journal of Orthopedics; American Journal of Sports Medicine; Cartilage, Educational Committee AANA, International Committee AANA, Journal of Bone and Joint Surgery – American, Journal of Shoulder and Elbow Surgery
Cole, Peter A.	3b, 5 – Synthes; 4 – BoneFoams Inc, LLC
Coleman, Struan H.	3b – Stryker
Collier, Rachel C.	n
Collins, Mark S.	n
Comstock, Dawn	8 – Journal of Athletic Training
Cooper, H. John	3b – Smith & Nephew
Costantini, Julian	n
Craig, Edward V.	1, 2, 3b – Biomet; 7, 8 – Wolters Kluwer Health – Lippincott Williams & Wilkins; 9 – AAOS, American Shoulder and Elbow Surgeons
Cram, Peter	n
Crist, Brett D.	2, 5 – Medtronic, Sonoma; 3b – KCI; 4 – Amedica Corporation, Orthopaedic Implant Company; 5 – Synthes, Wound Care Technologies; 8 – Journal of AAOS, Journal of Orthopaedic Trauma, Orthoinfo.org; 9 – Mid-Central States Orthopaedic Society, Orthopaedic Trauma Association
Crook, Karla J.	n
Cross, William W., III	2 – Synthes, AO North America; 3b – Zimmer
Crowther, Marshall	n
Cui, Quanqi	n
Cui, Shari	n
Cunningham, Matthew E.	n
Curtis, Daniel	n
Cutuk, Adnan	n
Dahm, Diane L.	1,4 – TENEX health (spouse); 9 – AAOS Arthroscopy and Sports Medicine Program Subcommittee, Arthroscopy Association of North America
Daniels, Alan H.	5 – Flexuspine, Synthes
Davis, Richard A.	n
Dawson, Courtney K.	n
Dawson, John R.	n
de Beaubien, Brian C.	2, 3b – ConvaTec, Stryker
Deierhoi, Rhiannon	n
Dekutoski, Mark B.	1, 2, 3b, 5 – Medtronic; 5 – DePuy, a Johnson & Johnson Company, Stryker, Synthes; 9 – Scoliosis Research Society

Del Core, Michael	n
Della Rocca, Gregory J.	2, 3b – Synthes; 3b – LifeNet Health, Intellectual Ventures; 4 – Amedica, Orthopaedic Implant Company; 5 – Wound Care Technologies, Eli Lilly, Sonoma Orthopaedics; 8 – Journal of the AAOS, Journal of Bone and Joint – 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; 9 – AAOS, American Society for Surgery of the Hand
DeSimone, Lori J.	n
DeSmet, Arthur A.	n
Determann, Jason R.	n
Dezfuli, Bobby	n
Dietrich, Lindsey N.	n
Dilisio, Matthew F.	n
DiPaola, Matthew J.	4 – Touch Consult; 7, 8 – iMedical Apps.com
DiPaolo, Zachary	n
Di Sanzo, Vincenzo	n
Dobbs, Ryan E.	n
Domingues, Brian	3a, 4 – Stryker; 4 – Corin, MAKO Surgical
Doty, Robert A., Jr.	n
Dreger, Tina K.	n
Dreyer, Rebecca E.	n
Dubiel, Matthew J.	n
Duchman, Kyle R.	n
Dudda, Marcel	n
Dulaney-Cripe, Elizabeth M.	n
Dumont, Guillaume D.	n
Duncan, Christopher M.	n
Durbin, Robert A.	4 – Johnson & Johnson
Dutta, Anil K.	1 – Ortho Helix; 2, 3b – Tornier
Dyck, P. James B.	n
Edwards, Alan D.	n
Edwards, Paul K.	n
Ekpo, Timothy E.	n
Elhassan, Bassem T.	n
Emery, Joe	n
Estrera, Kenneth A.	n
Etier, Brian E.	n
Evangelista, Peter	3b, 6 – Biomimetic
Evans, Richard P.	2 – Johnson & Johnson, Smith & Nephew
Everhart, Joshua S.	n
Fadale, Paul	5 – Arthrex, Inc., Mitek, Smith & Nephew
Faulkner, Nathan D.	n
Feller, Ross J.	n
Ferretti, Andrea	n
Figueroa, Nathania	n
Fine, Landon R.	n
Flanigan, David C.	2, 3b – Sanofi; 3b, 6 – Smith & Nephew; 5 – Zimmer; 5, 6 – Mitek; 6 – Arthrex, Inc., Biomet

Flower, Katie M.	n
Flynn, Jeffrey C.	9 – American Board of Medical Laboratory Immunology, Association of Medical Laboratory Immunology
Fortin, Paul T.	3b – Smith & Nephew, Stryker, Tornier; 5 – Musculoskeletal Transplantation Foundation
Fortunato, John	n
Freeman, Andrew	5 – LDR Spine, Medtronic, Smith & Nephew
Froimson, Mark I.	1, 3b – DePuy, a Johnson & Johnson Company; 2 – Cadence Pharmaceutical; 3b – MCS, CITI; 4, 6 – Medical Compression Systems; 6 – TissueLink, Stryker; 8 – American Journal of Orthopedics; 9 – American Association of Hip and Knee Surgeons, Mid-America Orthopaedic Association
Gadkari, Kuldeep	n
Galante, Jorge O.	3b, 6 – Biomet; 4 – Johnson & Johnson, Zimmer
Gallizzi, Michael A.	n
Gallo, Theresa J.	n
Ganz, Reinhold	3b – Lima Corporate; 3c, 4 – Pivot
Gao, Yubo	n
Garcia, Glenn M.	n
Gauger, Erich M.	n
Geeslin, Andrew G.	n
Genova, Renee	n
George, Martha	n
Georgiadis, Gregory M.	8 – Journal of Orthopaedic Trauma; 9 – American College of Surgeons, Committee on Trauma
Getelman, Mark H.	2, 3b – Mitek; 9 – Arthroscopy Association of North America
Ghacham, Wael	n
Ghate, Raju S.	3b – Zimmer
Ghodasra, Jason H.	n
Gilde, Alex K.	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; Mid-America Orthopaedic Association
Giuseffi, Steven A.	n
Goetz, Devon D.	8 – Clinical Orthopaedics and Related Research; 9 – Society for Arthritic Joint Surgery
Goldberg, Victor M.	2, 3b – Osteotech, Astrazenica; 4 – TissueLink; 5 – NIH, Sultzer/Zimmer; 7 – Elsevier; 8 – Journal of Bone and Joint Surgery-Amercan, Journal of Orthopaedic Research, Clinical Orthopaedics and Related Research, Osteoarthritis and Cartilage; 9 – OASRI, Bioinnovations Institute
Goldstein, Jeffrey M.	1, 3b – DePuy, a Johnson & Johnson Company; 1, 2, 3b – Smith & Nephew; 3b – Innomed; 8 – Journal of Arthroplasty
Goldstein, Wayne M.	1, 2, 3b , 5, 6 – DePuy, a Johnson & Johnson Company; 1, 2, 3b, 6 – Smith & Nephew; 4 – Doctors Research Group; 8 – Journal of Arthroplasty
Gordon, Alexander C.	2, 3b – DePuy, a Johnson & Johnson Company, OrthoSensor
Gottlieb, Meghan C.	n
Gould, Greg	n
Goulet, James A.	1 – Zimmer; 2 – Smith & Nephew; 4 – Pioneer Surgical Technology; 9 – American Orthopaedic Association, Michigan Orthopaedic Society, Orthopaedic Trauma Association
Gourineni, Prasad V.	4 – G2 Healthcare

Goyal, Nitin	n
Grabinski, Tessa M.	n
Graham, William C.	n
Grant, Sarah	n
Grappiolo, Guido	1, 2, 3b – Zimmer; 2, 3b – Biomet; 3c – Lima, Finceramica; 5 – Sanofi-Aventis
Gray, Benjamin L.	n
Graziano, Gregory P.	3c – Medtronic Sofamor Danek; 8 – The Spine Journal; 9 – AAOS, American Board of Orthopaedic Surgery, American Orthopaedic Association, Mid-America Orthopaedic Association
Green, Uthona	n
Greiner, Justin	n
Greis, Patrick E.	4 - Merck
Griesser, Michael J.	n
Griffith, Timothy B.	n
Gross, Christopher E.	n
Gryzlo, Stephen M.	n
Guanciale, Anthony F.	9 – Mid-America Orthopaedic Association, North American Spine Society
Guerra, James J.	n
Gulotta, Lawrence	8 – HSS Journal
Gum, Jeffrey L.	n
Guo, Xin	n
Gupta, Andrew S.	n
Gupta, Rishi R.	4 – MAKO
Guthrie, S. Trent	9 – Michigan Orthopaedic Society
Habbu, Rohan A.	n
Hadaway, Scott J.	n
Haegele, Ashley	n
Hakeos, William M.	4 – Sentio MMG
Haidukewych, George J.	1, 3b – DePuy, a Johnson & Johnson Company; 1 – Biomet; 3b - Smith & Nephew; 3b, 6 – Synthes; 4 – Orthopediatrics, Institute for Better Health; 8 – Journal of Orthopedic Trauma; 9 – AAOS
Hain, Kendra S.	n
Hallab, Nadim J.	2, 3b – Biomet, Medtronic Sofamor Danek; 2, 3b, 5 – Smith & Nephew; 5 – Zimmer;
Hamilton, David	n
Hamilton, Stephen C.	n
Hamilton, William G.	2, 3b, 5 – DePuy, a Johnson & Johnson Company; 2, 3b – Medtronic; 5 – Biomet, Inova Health Care Services
Hamula, Mathew	n
Hand, Steven	n
Harris, Joshua D.	n
Harston, Drew	n
Hasan, Saqib	n
Hastings, Mary	3b, 5 – Merck, Dr. Scholls; 7 – Elsevier
Hawn, Mary	n
Hayden, Brett	n
Hellman, Edward J.	2, 3b – Stryker
Hernandez, Melia	n
Hess, Daniel	n
Hettrich, Carolyn M.	9 – American Orthopaedic Society for Sports Medicine, Orthopaedic Research Society
Higuera, Carlos A.	n

Hildebolt, Charles F.	n
Hill, Brian W.	n
Hoeffel, Daniel P.	1 – Zimmer; 2, 3b, 5 – DePuy, a Johnson & Johnson Company
Hoegler, Joseph J.	2 – Synthes
Hoffmann, Martin F.	n
Holm, Jason S.	5 – Synthes
Holmes, David R.	n
Holmes, James R.	9 – American Foot and Ankle Society
Hopkins, Ronald	n
Horton, Walter E., Jr.	n
Hotchkiss, William R.	n
Houdek, Matthew T.	n
Hsu, Andrew R.	n
Hsu, Erin K.	3b – Graftys, Medtronic Sofamor Danek, Stryker, Zimmer; 3b, 5 – Pioneer Surgical; 5 – Baxter International; 8 – Journal of Spine Disorders and Techniques; 9 – AAOS, LSRS, RMEC
Hsu, Lawrence P.	n
Hsu, Wellington K.	3b – AONA, Lifenet, Medtronic, Pioneer Surgical, Stryker, Terumo, Zimmer; 5 – Baxter; 8 – Journal of Spinal Disorders and Techniques; 9 – AAOS, Lumbar Spine Research Society, North American Spine Society
Huang, Ronald	n
Hudak, Kevin	n
Hudgens, Joshua L.	n
Huo, Michael H.	2 – Cadence Pharmaceutical, Jassen; 3b – DePuy, a Johnson & Johnson Company; 9 – AAOS (Committee on Evaluation: self-assessment examination)
Hussain, Waqas M.	n
Hutchinson, Mark R.	6 – Arthrex, Inc.; 8 – American Journal of Sports Medicine, Journal of Bone and Joint Surgery-American, The Physician and Sports Medicine; 9 – AAOS, American Board of Orthopaedic Surgery, American College of Sports Medicine, American Orthopaedic Society for Sports Medicine, Arthroscopy Association of North America
Hymes, Robert	4 – Johnson & Johnson
Iannotti, Joseph P.	1, 2, 3b – DePuy, a Johnson & Johnson Company; 1 – Zimmer; 3b – Tornier; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins; 8 – Journal of Shoulder and Elbow Surgery
Iglesias, Rodrigo	n
Incavo, Stephen J.	1 – Innomed; 1, 2, 3b, 4, 5 – Stryker; 1, 2, 3b, 4 – Wright Medical Technology; 4 – Nimbic Systems; 5 – Surgical Monitoring Associates, Inc., Surgical Synergies, Synthes; 8 – Clinical Orthopaedics and Related Research, Journal of Arthroplasty, Journal of Bone and Joint Surgery, Journal of Orthopaedic Research, Knee, The Knee; 9 – AAOS, American Association of Hip and Knee Surgeons, Hip Society, Knee Society
Inwards, Carrie Y.	n
Iossi, Michael F.	6 – Arthrex, Inc.
Israel, Heidi	n
Jackson, Nancy M.	n
Jacobs, Joshua J.	4 – Implant Protection; 5 – Medtronic Sofamor danek, Nuvasive, Zimmer; 9 – AAOS
Jacobson, Aaron R.	n
Jacquet, Robin	n
Jamieson, Marissa D.	n

Jenkins, Tyler	n
Jennings, Jonathan K.	n
Jensen, M. Layne	n
Jia, Guang	n
Johnson, Anthony E.	2, 4 – Pfizer; 3b – Consultant, Orthopaedic Devices Panel, US Food & Drug Administration, Nexus Medical Consulting; 5 – Bergstrom Pharmaceuticals, Flexion Therapeutics; 8 – Clinical Orthopaedics and Related Research, Foot and Ankle Specialist, Military Medicine, British Journal of Sports Medicine; 9 – Society of Military Orthopaedic Surgeons
Johnson, Jeffrey E.	1, 3b, 4 – OrthoHelix Surgical Designs, Inc./Division of Tornier; 3b – Midwest Stone Institute, Inc., Medical Director; 4 – Midwest Therapy, LLC; 8 – American Journal of Orthopedics, Foot and Ankle International, Techniques in Foot and Ankle Surgery; 9 – AAOS, American Foot and Ankle Society, International Federation of Foot and Ankle Societies, Mid-America Orthopaedic Association
Johnson, Jeffrey S.	n
Johnson, Staci R.	n
Johnston, Jeffrey T.	n
Johnston, Richard C.	n
Jonah, David K.	n
Jones, Clifford B.	7 – Journal of Bone and Joint Surgery – American trauma newsletter; 8 – CORR, JBJS, JBJS Trauma Newsletter, Journal of Orthopaedic Trauma, OCNA; 9 – AOA Own the Bone Board, Michigan Orthopaedic Society PAC Secretary, Mid-America Orthopaedic Association By-Laws Committee, OTA Outcomes and Classification Committee
Jones, Daniel A.	5 – Arthrex, Inc., Smith & Nephew
Jones, David B.	n
Jones, Kerwyn C.	3b – Orthopediatrics
Jones, Morgan H.	5 – Arthrosurface
Joos, David A.	n
Julka, Abhishek	n
Junko, Jeffrey T.	n
Jupiter, Jesse B.	3b, 4 – OHK; 3c – Synthes, Trimed; 5 – AO Foundation; 7 – Elsevier Thieme; 8 – Journal of Hand Surgery American, Journal of Orthopaedic Trauma, Techniques in Hand and Upper Extremity Surgery, Hand; 9 – AAHS Board Curriculum Committee
Kaar, Scott G.	n
Kaeding, Christopher C.	3b – Biomet; 5 – Omeros Company; 9 – American Orthopaedic Society for Sports Medicine, Mid-America Orthopaedic Association Audit Committee
Kakar, Sanjeev	3b – Arthrex, Inc.
Kalawadia, Jay V.	n
Kalisvaart, Michael M.	n
Kane, Patrick	n
Kang, Matthew M.	n
Karam, Matthew D.	n
Karas, Vasili	n
Karges, David E.	n
Karim, Azim	n
Kay, David B.	3c, 4 – OrthoHelix Surgical Designs; 8 – Foot and Ankle International; 9 – American Orthopaedic Foot and Ankle Society
Keene, James S.	9 – American Orthopaedic Society for Sports Medicine
Keeney, James A.	9 – Society of Military Orthopaedic Surgeons

Kelikian, Armen S.	7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Kendall, Mark	n
Khalil, Jad G.	6 – GE Healthcare
Khazzam, Michael S.	n
Kho, Jenniefer Y.	n
Khoury, Basma M.	n
Kiefhaber, Thomas R.	9 – American Society for Surgery of the Hand
Kiely, Paul D.	n
Kim, Young-Jo	2 – Synthes; 3b – Smith & Nephew; 3c, 6 – Siemens
Kishore, Vipuil	n
Klaassen, Alison L.	n
Klein, Sandra E.	n
Klika, Alison K.	n
Knapik, Derrick M.	n
Knight, Justin R.	n
Knopp, Michael V.	n
Knutson, Zakary A.	n
Kodali, Pradeep	n
Kodros, Steven A.	n
Kolovich, Greg	n
Koruprolu, Sarath C.	n
Koueiter, Denise	n
Kovacevic, David	n
Kraay, Matthew J.	3c – Zimmer; 9 – AAOS, Arthritis Foundation
Kraeutler, Matthew J.	n
Kralovec, Michael E.	n
Krebs, Viktor E.	1, 2, 3b – Shukla Medical (Extract-All); 2, 3b – Salient Surgical/Medtronic, Stryker Orthopaedics; 8 – Journal of Arthroplasty
Krishnamurthy, Anil B.	n
Krishnan, Sumant G.	1 – Ossur, TAG Medical; 1, 2, 3b, 4, 6 – Tornier; 4 – Johnson & Johnson; 7 – Wolters Kluwer; 8 – AJSM, JBJS, JSES; 9 – AANA, ASES
Kruppa, Christiane G.	n
Krych, Aaron J.	n
Kuhn, Kevin M.	n
Kuhns, Craig A.	3b – Stryker; 4 – Doctors Research Group
Kundukulam, Joseph A.	n
Kurdziel, Michael D.	n
Kurtz, William B.	n
Kuzma, Scott A.	n
Kvam, Vanessa	n
Kwasny, Mary J.	n
Kwon, Young W.	n
Labianca, Luca	n
Labib, Sameh A.	2, 3b – Arthrex, Inc.; 3b – Arthrosurface; 4 – ConforMIS, Inc., Zimmer; 9 – AAOS, American Orthopaedic Foot and Ankle Society
Lacy, Kyle W.	n
Lafferty, Paul M.	n
LaFleur, Brett C.	n
Landis, William J.	n
Larkin, Brian J.	n
Larkins, Christopher	n
Larson, A. Noelle	n
Larson, Evan P.	n

Lattermann, Christian	2, 3b – Sanofi, Genzyme; 3b – Zimmer; 5 – Smith & Nephew; 8 – Cartilage, Journal of Sports Physiology; 9 – International Cartilage Repair Society
Laughlin, Richard T.	2 – AO North America, Smith & Nephew, Synthes; 3b – Premier Health Partners Ortho Institute, World Arthrosis Organization; 3b, 9 – South Surgery Center, LLC; 3c – Community Tissue Bank; 5 – Grants: Ohio Third Frontier, Orthopaedic Trauma Association; 5, 9 – AOFAS, Wright State University Boonshoft School of Medicine; 9 – Dayton Area Graduate Medical Education Consortium, Mid-America Orthopaedic Association, Wright State Physicians, Inc.
Laughlin, Ruple S.	n
Lawton, Jeffrey N.	3b – Innomed
Lawton-Peters, Sheila	n
Lazarus, Mark D.	1, 2, 3b, 4, 5 – Tornier; 2 – Arthrex, Inc., Synthes
Lee, Jungwha	n
Lehman, Wallace B.	n
Lerner, Benjamin A.	n
Les, Clifford M.	n
Levine, Brett R.	3b – DePuy, a Johnson & Johnson Company, Johnson & Johnson; 3b, 5 – Zimmer; 5 – Biomet; 8 – Human Kinetics, Orthopedics, SLACK Incorporated; 9 – AAOS
Levy, Bruce A.	1 – VOT Solutions; 1, 3b – Arthrex, Inc.; 2 – Canadian Orthopedic Association; 8 – Arthroscopy, Journal of Knee Surgery, Knee Surgery, Sports Traumatology; 9 – Arthroscopy Association of North America (ISAKOS representative)
Lewallen, David G.	1 – Zimmer; 3b,4 – Pipeline Biomedical Holdings; 8 – Clinical Orthopaedics and Related Research; 9 – American Joint Replacement Registry, Hip Society, Orthopaedic Research and Education Foundation
Lewallen, Laura W.	1, 5 – Zimmer; 2 – Osteotech; 3b, 4 – Pipeline Biomedical Holdings
Lewis, Jamie	n
Li, Jia	3a – Zimmer
Li, Mengnai	n
Li, Xinning	n
Lien, John R.	n
Lipman, Joseph	1 – Mathys Ltd., Ortho Development Corporation; 3b – Ivy Capital Partners, LLC; 5 – Stryker
Lippe, Julienne	n
Liu, Steve S.	n
Lobatto, Daniel	n
Lombardi, Adolph V., Jr.	1, 2, 3b, 5 – Biomet; 1 – Innomed; 5 – Stryker; 8 – Clinical Orthopaedics and Related Research, Journal of Arthroplasty, Journal of Bone and Joint Surgery – American, Journal of the American Academy of Orthopaedic Surgeons, Journal of Orthopaedics and Traumatology, Surgical Technology International; 9 – Hip Society, Knee Society, New Albany Surgical Hospital Foundation, Orthopaedic Research and Education Foundation
Lu, Xin	n
Luebbers, Matthew	n
Luo, Michael	n
Ly, Thuan V.	n
Lyons, Christopher	n
Ma, Richard	n
Machan, Jason T.	8 – Journal of Applied Biomechanics, Journal of Pediatric Urology

MacKenzie, Ellen J.	8 – Injury; 9 – National Trauma Institute
Maerz, Tristan	n
Mahoney, Craig R.	4 – Trak Surgical, Inc; 5 – Smith & Nephew; 9 – AAOS, Iowa Orthopaedic Society, Mid-America Orthopaedic Association, Polk County Medical Society
Malawer, Martin M.	n
Malcolm, Tennison	n
Malhotra, Gautam	n
Mall, Nathan A.	7 – Vindico Medical Education
Maloney, William J.	1 – Wright Medical Technology, 3b, 4 – Pipeline Orthopaedics; 4 – Abbott, Gillead, ISTO Technologies, Johnson & Johnson, Merck, Moximed, Pfizer, TJO; 8 – Journal of Orthopaedic Research, Journal of Orthopaedic Science; 9 – AJRR, Knee Society, Western Orthopaedic Association
Manley, Mary	n
Manoli, Arthur, II	1 – DJ Orthopaedics; 2 – Stryker; 2, 6 – Synthes; 8 – Foot and Ankle International; 9 – Michigan Orthopaedic Society
Marberry, Kevin M.	n
Marcantonio, David	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.	1, 2, 3b, 4, 5 – Stryker; 4 – Arbotetum Ventures, 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 – AAHKS, Michigan Orthopaedic Society, Mid-America Orthopaedic Association
Markert, Ronald J.	n
Markiewitz, Andrew D.	7 – CRC Press; 8 – Journal of Bone and Joint Surgery-American, Journal of Hand Surgery-American; 9 – Academy of Medicine of Cincinnati, AAOS, Mid-America Orthopaedic Association, Ohio State Medical Association
Marquez-Lara, Alejandro	n
Marsh, David G.	n
Marsh, J. Lawrence	1 – Biomet; 3b – Orthohelix; 4 – FxRedux; 7 – Oxford Press; 9 – ACGME Residency Review Committee, American Board of Orthopaedic Surgery, Inc., American Orthopaedic Association, Mid-America Orthopaedic Association, National Board of Medical Examiners
Martell, John M.	1 – UCTech patent from University of Chicago; 3b – StelKast, Inc.
Martin, Christopher T.	n
Martin, J. Ryan	n
Martus, Jeffrey E.	9 – Pediatric Orthopaedic Society of North America
Maskill, John D.	n
Mason, James	n
Masse, Alessandro	n
Matsuda, Dean K.	1 – Arthrocare, Biomet, Smith & Nephew; 8 – Arthroscopy, Orthopedics Today; 9 – Orthopedics Overseas
Mattingly, Theresa K.	n
May, Jedediah H.	n
May, Matthew	3a – Vipaar, LLC; 4 – Vipaar, LLC
McAndrew, Christopher	2 – Synthes; 7 – Journal of Bone and Joint Surgery – American
McCormick, Jeremy J.	2 – Integra, Synthes; 5 – Wright Medical Technology, Inc.; 6 – Midwest

	Stone Institute; 9 – American Orthopaedic Foot and Ankle Society
McCoy, Brett W.	n
McDonald, Colin P.	n
McDonald, Douglas J.	9 – Musculoskeletal Tumor Society
McDonald, Tyler C.	n
McGwin, Gerald	n
McIntosh, Amy L.	3b – Synthes; 9 – Mid-America Orthopaedic Association
McKinley, Todd O.	9 – Orthopaedic Trauma Association
McLaughlin, Jeffrey R.	1, 2, 3b, 5 – Biomet; 9 – Mid-America Orthopaedic Association
McLendon, Paul B.	n
McNeilan, Ryan J.	n
McShane, Michael A.	3a – Zimmer (son); 3b, 5 – Zimmer
Meadows, James R.	n
Mehle, Susan C.	n
Meier, Joshua W.	n
Melhoff, Thomas Lynn	n
Mellecker, Chloe J.	n
Mendoza-Lattes, Sergio A.	2, 3b – Globus Medical; 2, 3b, 5 – Medtronic Sofamor Danek; 3b – Synthes; 5 – Stryker; 8 – Clinical Orthopaedics and Related Research, Journal of Bone and Joint Surgery – American, Spine
Meneghini, R. Michael	1, 2, 3b – Stryker; 8 – JBJS, Journal of Arthroplasty, Knee Newsletter
Merrick, Michael T.	n
Merz, Michael K.	n
Mileti, Joseph	n
Miller, Benjamin J.	9 – Musculoskeletal Tumor Society
Miller, Benjamin S.	n
Miller, Dane A.	3a, 4 – Biomet, Inc.
Millis, Michael B.	7, 8 – Saunders/Mosby-Elsevier; 8 – Springer
Miniaci, Anthony	1, 2, 3b, 4, 6 – Arthrosurface; 1, 3b, 4 – Zimmer; 3b – Smith & Nephew; 3b, 4, 6 – Stryker; 4 – DePuy, a Johnson & Johnson Company, Medtronic; 9 – American Shoulder and Elbow Surgeons, American Othopaedic Society for Sports Medicine, Arthroscopy Association of North America, International Society of Arthroscopy, Knee Surgery, Orthopaedic Sports Medicine
Mir, Hassan R.	8 – Journal of the AAOS, Journal of Bone and Joint, Journal of Orthopaedic Trauma, OTA Newsletter; 9 – AAOS, Orthopaedic Trauma Association
Mitchell, Joshua M.	n
Moed, Berton R.	1 – Biomet; 7, 8 – Clinical Orthopaedics and Related Research; 8 – Injury, Journal of Orthopaedic Trauma; 9 – AO Foundation, AO North America
Moeller, Amy T.	n
Molina, Cesar S.	n
Molloy, Robert M.	2, 3b, 5 – Stryker
Mont, Michael A.	1, 3b, 5 – Stryker, Wright Medical Technology; 3b – Biocomposites, Medtronic; 3b, 5 – DJ Orthopaedics, Joint Active Systems, Sage Products, Inc., TissueGene; 3b – Janssen; 5 – National Institutes of Health (NIAMS & NICHD); 8 – American Journal of Orthopedics, Journal of Arthroplasty, Journal of Bone and Joint Surgery – American, Journal of Knee Surgery, Surgical Techniques International; 9 – AAOS
Montanaro, Antonello	n
Moore, Amy M.	n
Moore, Drew D.	n
Moravek, James E., Jr.	n

Morcuende, Jose A.	9 – AAOS, POSNA, USBJI
Moretti, Vincent M.	n
Morgan, Robert A.	6 – Zimmer
Moric, Mario	n
Morscher, Melanie A.	n
Mostardi, Richard A.	n
Motley, John R.	n
Mott, Michael P.	9 – Mid-America Orthopaedic Association
Moutzouros, Vasilios	n
Mueller, Chris	n
Mulawka, Brett	n
Mulder, Michelle B.	n
Mullens, Jess	n
Mullis, Brian	2, 5 – Synthes; 5 – Amgen Co.; 8 – Journal of Orthopaedic Trauma; 9 – Orthopaedic Trauma Association
Murphy, Robert F.	n
Murray, Michael R.	n
Murray, Trevor G.	n
Murtha, Yvonne M.	9 – AAOS
Mutnal, Amar	4 – Genentech; 6 – Cayenne Medical
Myers, Devon	n
Myers, Thomas	n
Nader, Antoun	5 – Pfizer
Nagaraja, Haikady N.	8 – Annals of Pharmacotherapy
Nam, Jin	n
Narducci, Anthony	n
Nasr, Kerellos A.	n
Nassr, Ahmad N.	5 – Synthes; 9 – Scoliosis Research Society
Neal, Deborah R.	n
Nelms, Nathaniel J.	n
Nelson, Christopher D.	3b – Mitek
Nelson, Kenneth J.	n
Nepple, Jeffrey J.	n
Ng, Vincent Y.	n
Nguyen, Joseph	n
Nicholson, Lisa M.	n
Nickoli, Michael	n
Noble, Jeffrey S.	2, 3b – Stryker
Noble, Philip C.	1, 3b – Omni Sciences, Inc.; 1 – Smith & Nephew, Stryker; 1, 7 – Springer; 1, 3b, 5 – Zimmer; 5 – Synthes; 8 – Journal of Arthroplasty
Noe, Donald	n
Noel, Curtis R.	2, 3b, 5 – Arthrex; 2, 3b – Exactech, Inc.; 5 – Breg, Tornier
Noiseux, Nicolas O.	3b – Wright Medical Technology, Inc.; 5 – Zimmer
Norton, Adam	n
Novais, Eduardo N.	n
Nuber, Gordon W.	4 – Johnson & Johnson, Stryker; 5 – Smith & Nephew
Nuckley, David J.	5 – Medtronic Sofamor Danek
Nunley, Ryan M.	3b – CardioMEMS, Integra Sciences, Medtronic; 3b, 5 – Smith & Nephew, Wright Medical Technology, Inc.; 5 – Biomet, EOS Imaging, Medical Compression Systems, Stryker; 9 – Missouri State Orthopaedic Association, Southern Orthopaedic Association
Nyazee, Humaa	n
Nystrom, Lukas M.	n
Oak, Nikhil R.	n

Oh, Sanders	n
Ohrt, Gary T.	n
O'Leary, Patrick F.	n
Onyekwelu, Ikemefuna	n
Orfaly, Robert M.	1, 2, 3b – Acumed, LLC; 8 – Journal of Hand Surgery – American; 9 - AAOS
Orr, Scott P.	n
Otterberg, Erik T.	9 – Lakeside Hospital, Mid-America Orthopaedic Association
Otto, Thomas J.	n
Padley, Michelle A.	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
Paisley, Kevin C.	n
Paletta, George P.	n
Paller, David	n
Palumbo, Brian	5 – Medtronic
Palumbo, Mark A.	2, 3b, 5 – Globus Medical; 2, 3b – Medtronic, Stryker
Paprosky, Wayne G.	1 – Wright Medical Technology, Inc.; 1, 2, 3b – Zimmer; 3b – Biomet; 7, 8 – Journal of Arthroplasty; 9 – Hip Society
Park, Andrew	n
Parker, Richard D.	2, 3b – Smith & Nephew; 2, 3b, 5 – Zimmer
Parks, Joseph A.	n
Parvizi, Javad	2, 3b – Cadence; 3b, 5 – 3M, Smith & Nephew, Zimmer; 3b – CeramTec, Pfizer, Salient Surgical, TissueGene; 5 – Baxter, DePuy, a Johnson & Johnson Company, Musculoskeletal Transplant Foundation, National Institutes of Health (NIAMS & NICHD), Stryker; 7 – jaypee, Journal of Arthroplasty, Journal of Bone and Joint Surgery – American, 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 Arthroplasty, Journal of Bone & Joint Surgery – American, Journal of Bone and Joint Surgery – British, Journal of the AAOS, Magnifi Group, Orthopedics Today; 9 – American Association of Hip and Knee Surgeons, American Board of Orthopaedic Surgery, Inc., British Orthopaedic Assocation, CD Diagnostics, Eastern Orthopaedic Association, Hip Society, Orthopaedic Research and Education Foundation, Orthopaedic Research Society, Philadelphia Orthopedic Society, Smartech, United Healthcare
Pashos, Gail E.	4 – GlaxoSmith Kline
Pastor, Andrew J.	4 – celldex
Patel, Anay R.	n
Patel, Preetesh D.	3b – Stryker; 4 – OtisMed Corporation
Patel, Ronak M.	n
Patthanacharoenphon, Cameron G.	n
Paxton, E. S.	n
Pearsall, Albert W., IV	3b – Biomet; 5 – Luitpold Pharmaceuticals, Inc.; 9 – LifeLink
Pedersen, Douglas R.	n
Peelman, Jessica	n
Peers, Sebastian C.	n
Perera, Priyangi M.	n
Peterson, Ham	7 – Springer; 8 – Journal of Pediatric Orthopedics B (European)
Perry, Kevin I.	n
Pfeiffer, Ferris	n

Philippon, Marc J.	1, 3b, 5, 6 – Smith & Nephew; 1 – Bledsoe, Donjoy; 1, 4 – Arthrosurface; 3b, 4 – MIS; 4 – Hipco; 5 – Arthrex, ConMed, Linvatec, Össur, Siemens; 7 – SLACK Incorporated, Elsevier; 9 – AOSSM, International Society for Hip Arthroscopy, Steadman Philippon Research Institute
Phillips, Jonathan H.	1, 2, 3b, 5 – Biomet; 3b – Synthes; 8 – Journal of the Southern Orthopaedic Association; 9 – OrthoPaediatrics, Scoliosis Research Society
Phillips, Tamara	n
Phisitkul, Phinit	3b – Arthrex, Inc.; 4 – MTP Solutions; 9 – American Orthopaedic Foot and Ankle Society, Research Committee
Pierce, William A.	n
Piper, Christine C.	3a – Aesculap/B. Braun, Medtronic
Place, Howard M.	9 – Scoliosis Research Society
Plantikow, Carla J.	n
Podeszwa, David A.	9 – AAOS, Pediatric Orthopaedic Society of North America
Politi, Joel R.	2, 3b – DePuy, a Johnson & Johnson Company
Polley, Nathan	n
Polly, David W., Jr.	n
Ponce, Brent A.	2 – Arthrex, Inc., Tornier
Popa, Matthew A.	n
Post, Joel M.	n
Potter, G. David	n
Prayson, Michael J.	2, 3b – Smith & Nephew; 2 – AO faculty; 8 – Acta Orthopaedica, Journal of Orthopaedic Trauma; Journal of Trauma
Prewitt, Erin M.	n
Prinzbach, Ariana A.	n
Prior, Fred W.	n
Pugely, Andrew J.	n
Puri, Lalit	1 – Innomed; 1, 3b – Stryker; 3b – Kinamed, Salient Surgical
Puskas, Judit E.	n
Queen, Robin M.	5 – DJ Orthopaedics, Nike, Inc., Stryker; 8 – Foot and Ankle International
Raines, Benjamin Todd	n
Ramsey, Matthew L.	1, 3b, 5 – (Integra) Ascension, Zimmer; 2 – Arthrex, Inc.; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins; 8 – Journal of Shoulder and Elbow Surgery, Orthopedics Today; 9 – AAOS, Philadelphia Orthopaedic Society, Rothman Institute, Rothman Specialty Hospital
Reader, Douglas	n
Reich, Michael S.	n
Reimer, Nickolas B.	n
Reinert, Steve E.	n
Reisch, Joan S.	n
Reitman, Charles A.	n
Ren, Weiping	n
Rhee, Peter C.	n
Ricchetti, Eric T.	n
Richards, Daniel	2 – Arthrex, Inc.
Richardson, David R.	n
Richman, Joshua	n
Rienert, Steve	n
Rieser, Geoffrey R.	n
Riggs, Cassandra	n
Ritterman, Scott A.	4 – Bristol-Myers Squibb

Roberts, Craig S.	7 – Elsevier; 8 – Injury, Journal of Orthopaedic Trauma, 9 – AAOS, Kentucky Orthopaedic Society, Mid-America Orthopaedic Association, Orthopaedic Trauma Association
Robertson, William J.	3b – ConMed Linvatec
Rogers, Jason M.	n
Rose, Peter S.	7, 8 – Journal of AAOS; 8 – Yearbook of Orthopaedics; 9 – AAOS, Collaborative Spine Research Foundation, Minnesota Orthopaedic Society
Ross, James R.	n
Ross, Matthew S.	n
Rossi, Roberto	n
Rubino, L. Joseph	n
Ruder, John	n
Ruh, Erin L.	n
Russell, Robert D.	n
Russo, Scott S.	2 – Medtronic Sofamor Danek; 3c – Biomet, Bespa; 4 – Pfizer, Micromachines
Ruth, John T.	9 – Orthopaedic Trauma Association
Saad, Mohamed	n
Sabesan, Vani J.	5 – Tornier; 9 – Kalamazoo Academy of Medicine
Sadr, Kamran N.	n
Sahota, Shawn	n
Salassa, Tiare E.	n
Saluan, Paul M.	2 – Arthrex, Inc.; 3c – Triatrix, LLC; 5 – Zimmer
Samuelson, Eric M.	n
Sanchez-Sotelo, Joaquin	1, 5 – Stryker; 5 – DePuy, Zimmer; 8 – Journal of Shoulder and Elbow Surgery
Sanders, Peter C.	n
Santos, Edward Rainier G.	n
Sarwark, John F.	7, 9 – American Academy of Pediatrics; 8 – AAOS
Sassoon, Adam A.	n
Saucedo, James M.	n
Savage, A. Jay	n
Savage, Jason W.	n
Scallon, Gregory L.	n
Schildhauer, Thomas A.	2, 3b – Smith & Nephew, Zimmer; 8 – Journal of Orthopaedic Trauma
Schlatterer, Daniel R.	n
Schoch, Bradley S.	n
Schoenecker, Jonathan G.	5 – ISIS Pharmaceuticals
Schoenecker, Perry L.	8 – Journal of Children's Orthopaedics, Journal of Pediatric Orthopaedics; 9 – Pediatric Orthopaedic Surgery of North America
Schold, Jesse	n
Schrader, William C.	n
Schroeder, Gregory D.	n
Schub, David L.	n
Schwindel, Leslie E.	n
Sebastian, Arjun S.	n
Seethala, R.	n
Sekundiak, Todd	1, 2, 3b, 3c – Zimmer; 3c, 5 – Stryker; 8 – Journal of Arthroplasty
Sembrano, Jonathan N.	5 – Nuvasive; 9 – North American Spine Society, Society of Lateral Access Surgery
Sems, S. Andrew	1 – Biomet
Shaheen, Philip	n
Shasti, Mark	n

Sheppard, Evan	n
Sherman, Courtney E.	n
Sherman, Seth L.	n
Shin, Alexander Y.	5 – American Association for Hand Surgery, Integra Life Sciences, Musculoskeletal Transplant Foundation; 8 – Journal of Bone and Joint Surgery – American, Journal of Hand Surgery – American; 9 – American Society for Surgery of the Hand
Shingles, Michael D.	3b – Biomet
Shishani, Yousef	n
Shives, Thomas C.	1 – DJ Orthopaedics
Siegel, Herrick J.	3b – Acumed, LLC; 8 – Journal of Foot and Ankle Surgery
Sierra, Rafael J.	1 – Biomet Amplitude, 2, 3b, 5 – Biomet; 2 – Arthrex, Inc.; 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, NAON Evidence Base Practice and Research Committee, NOF Nursing Advisory Council, Orthopaedic Trauma Association
Silverman, Andrew M.	n
Sim, Franklin H.	7 – Saunders/Mosby-Elsevier
Simons, Matthew J.	n
Sinacore, David R.	n
Sinatra, Philip M.	n
Sink, Ernest L.	3b – Pivot; 9 – Pediatric Orthopaedic Society of North America
Sismondo, Ronald A.	n
Siston, Robert A.	5 – MAKO Surgical Corp., National Institutes of Health (NIAMS & NICHD)
Skipor, Anastasia K.	6 – Medtronic Sofamor Danek, Nuvasive, Spinal Motion, Wright Medical Technology, Inc., Zimmer
Slettedahl, Seth W.	n
Slinkard, Nathaniel J.	n
Small, Travis J.	n
Smith, Carole A.	n
Smith, Casey L.	n
Smith, Hugh M.	n
Smith, Matthew J.	2 – DePuy, a Johnson & Johnson Company
Smith, Richard A.	n
Smith, Travis H.	3a – Medical Science Products, Inc.
Soltesz, Edward	n
Song, Bowei	n
Souza, Bruno Goncalves Schroder	n
Spalding, Steven J.	n
Spencer, Edwin E., Jr.	1, 3b, 4, 5 – Tornier; 5 – DePuy, a Johnson & Johnson Company
Sperl-Imhoff, Ericka L.	n
Sperling, John W.	1 – Biomet, DJ Orthopaedics; 3b, 4 – Tornier; 4 – Emerge Medical; 8 – Journal of Shoulder and Elbow Surgery, SLACK
Spinner, Robert J.	3b – Mayo medical Ventures; 8 – Clinical Anatomy, Journal of Surgical Orthopedic Advances, Mayo Clinic Proceedings, Neurosurgery, World Neurosurgery; 9 – American Society for Peripheral Nerve
Sporer, Scott M.	3b – Smith & Nephew, 3b, 5 – Zimmer; 5 – Central Dupage Hospital; 7 – SLACK Incorporated
Springer, Bryan D.	2 – DePuy, a Johnson & Johnson Company; 3b – Stryker Convatec Surgical

SPRINT Investigators	n
Staff, Nathan P.	n
Stannard, James P.	2, 3b – KCI, Medtronic Sofamor Danek; 3b – Smith & Nephew, Sonoma; 7 – Theime; 8 – Journal of Knee Surgery; 9 – Orthopaedic Trauma Association
Steele, John	n
Steensma, Matthew	n
Steiner, Richard	n
Steiner, Samuel R. H.	n
Steinmann, Scott P.	n
Stern, Peter J.	8 – Journal of Bone and Joint Surgery – American
Stitzlein, Russell N.	n
Stockton, Kristopher G.	n
Stone, Eugene	n
Stouffer, Mark H.	n
Streubel, Philipp N.	n
Strube, Michael J.	n
Stuart, Michael J.	1, 3b – Arthrex, Inc.; 5 – Stryker; 8 – American Journal of Sports Medicine; 9 – AAOS, American Orthopaedic Society for Sports Medicine
Stubbart, James R.	n
Stulberg, Bernard N.	1, 3b – Exactech, Inc.; 2, 5 – Corin U.S.A.; 2 – Medtronic; 3b – Stryker; 5 – Zimmer; 8 – Journal of Arthroplasty; 9 – Mid-America Orthopaedic Association
Stulberg, S. David	1 – Biomet, Innomed; 1, 2, 3b – Aesculap/B.Braun; 2, 3b – Zimmer; 2, 3b, 4 – Stryker; 4 – Johnson & Johnson; 7 – Peachtree Publishers
Suarez, Juan C.	3b – OrthAlign
Sucato, Daniel J.	3c – Orthopediatrics; 7 – Saunders/Mosby-Elsevier; 9 – AAOS, Pediatric Orthopaedic Society of North America, Scoliosis Research Society
Sutphen, Sean	n
Sweitzer, Brett	n
Swiontkowski, Marc F.	3b – Eli Lilly, Zimmer; 7 – Saunders/Mosby-Elsevier, Wolters Kluwer Health - Lippincott Williams & Wilkins; 8 – Journal of Bone and Joint Surgery-American; 9 – Mid-America Orthopaedic Association
Szubski, Caleb R.	n
Taher, Fadi	n
Takenaga, Ryan K.	n
Tallmage, Anne	n
Tank, Jason C.	n
Tanner, John C.	3a – Hospira (father); 4 – Abbott/Hospira (parents)
Tatman, Penny J.	n
Tavakolian, Paul	n
Taylor, Benjamin C.	8 – Orthobullets.com
Templeman, David C.	1, 2 – Zimmer; 3b – Baxter, Biomet; 3c – Orthofix, Inc.; 9 – Orthopaedic Trauma Association, SIGN
Templeton, Kimberly J.	3c – Zimmer; 9 – USBJI
Tetreault, Matthew W.	n
Thakur, Nikhil A.	n
Thedens, Daniel R.	n
Thomas, Geb W.	n
Thompson, Matthew M.	n
Throckmorton, Thomas W.	2, 3b, 5 – Biomet; 3b – Zimmer; 7 – Saunders/Mosby-Elsevier; 9 – AAOS, Mid-America Orthopaedic Association

Tomich, David	n
Toolan, Brian C.	4 – Pfizer; 8 – Foot and Ankle International; 9 – American Orthopaedic Association, American Orthopaedic Foot and Ankle Society
Torchia, Michael E.	n
Trivellas, Andromahi	n
Trousdale, Robert T.	1, 3b – DePuy, a Johnson & Johnson Company, MAKO, Wright Medical Technology; 9 – Mid-America Orthopaedic Association
Truchan, Lisa M.	n
Tucker, Michael C.	n
Turchetto, Luigino	n
Turner, Norman S.	3b – Bacterin International; 9 – Mid-America Orthopaedic Association
Turturro, Francesco	n
Van Demark, Robert E., III	n
Vang, Sandy	n
Vasileff, William K.	n
Vemulpalli, Krishna C.	n
Verma, Nikhil N.	1, 3b, 5 – Smith & Nephew; 3b, 5 – Arthrex, Inc.; 4 – Omeros; 5 – Athletico, ConMed Linvatec, Miomed, Mitek; 7 – Arthroscopy, Vindico Medical-Orthopedics Hyperguide; 8 – Arthroscopy, Journal of Knee Surgery, SLACK Incorporated; 9 – Arthroscopy Association Learning Center Committee
Vick, Catherine	n
Vikus, Walter W.	n
Vilensky, Seth	n
Villalobos, Camilo E.	n
Volgas, David A.	5 – Pfizer
Vopat, Bryan G.	n
Vourazeris, Jason D.	n
Wagner, Eric R.	n
Wagner, Matthew	n
Wahl, Christopher J.	2 – Arthrex, Inc.; 2, 3b – Smith & Nephew
Walker, Ashley C.	n
Wang, Joanne	n
Wanke, Tyler R.	n
Warren, Russell F.	1 – Biomet, Smith & Nephew; 4 – Cayenne, Orthonet, Regen Biologics; 7, 8 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Warth, Lucian C.	n
Watson, J. Tracy	1 – Biomet, DePuy, a Johnson & Johnson Company; 1, 3b – Smith & Nephew; 2 – Medtronic, Stryker; 3b – Bioventus; 3c – Accelalox, Ellipse; 8 – Ortho Knowledge Online; 9 – Orthopaedic Trauma Association
Watson, James C.	n
Watson, Jonathan N.	3a – Nuvasive
Webb, Jonathan E.	n
Wei, Wenbo	n
Weiner, Dennis S.	n
Weiner, Scott D.	5 – Stryker; 9 – American Orthopaedic Association, Mid-America Orthopaedic Association, Musculoskeletal Tumor Society
Weis, Marcia	9 – Orthopaedic Nurse Certification Board
Wellman, Samuel S.	5 – DePuy, a Johnson & Johnson Company, Stryker, Zimmer
Wenger, Doris E.	n
Wera, Glenn D.	n
Westberg, Jerald R.	n
Westermann, Robert W.	n

Wetters, Nathan G.	n
Whiting, Daniel R.	n
Wiater, Brett P.	n
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
Wicks, Eric	n
Widmer, Steven	n
Wilke, Benjamin K.	n
Williams Gerald R., Jr.	1, 2, 3b – DePuy, a Johnson & Johnson Company; 3c – IMDS; 4 – In Vivo Therapeutics; 5 – Tornier; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins; 8 – Operative Techniques in Orthopaedics, Techniques in Shoulder and Elbow Surgery; 9 – American Shoulder and Elbow Surgeons, Mid-Atlantic Shoulder and Elbow Society, Pennsylvania Orthopaedic Society
Williams, Joan R.	n
Williams, Phillip	n
Willman, Tyler J.	n
Wilson, Benjamin R.	n
Wilson, Joyce	n
Wilson, Meadow	n
Wilson, Philip L.	7 – Elsevier
Wilton, Peter	n
Winans, Charles G.	n
Wittig, James C.	n
Wolf, Brian R.	9 – American Orthopaedic Society for Sports Medicine, Arthroscopy Association of North America, Mid-America Orthopaedic Association
Wooldridge, Caitlin R.	n
Wooten, Clint J.	n
Wright, Neill M.	1, 3b – Nuvasive; 3b – Ulrich Medical; 4 – Vertebral Technologies, Inc.; 9 – Cervical Spine Research Society
Wright, Rick W.	3b – Flexion Therapeutics; 5 – National Institutes of Health (NIAMS & NICHD), Smith & Nephew; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Wright, Timothy M.	1 – Mathys Ltd; 4 – Exactech, Inc.; 5 – Stryker, Synthes; 7 – Journal of Orthopaedic Research, Wolters Kluwer Health – Lippincott Williams & Wilkins; 8 – Journal of Orthopaedic Research 9 – Knee Society
Wuerz, Thomas H.	n
Wyland, Douglas J.	5 – Arthrex, Inc., Arthrocare, Arthrosurface, Breg, Canon, DJO Surgical, Ferring Pharmaceuticals, Greenville Hospital System, Smith & Nephew, Tornier
Wyles, Cody	n
Xu, Meng	n
Yaffe, Mark A.	n
Yager, Craig	n
Yanke, Adam B.	n
Yehyawi, Tameem M.	n
Yi, Seung J.	n
Yoon, Patrick	3b – Arthrex, Inc., Orthofix, Inc.; 5 – Synthes
Young, Matthew D.	4 – Amgen Co., Eli Lilly, Norvartis
Yson, Sharon C.	n
Yuan, Brandon J.	n

Yuasa, Masato	n
Zadzilka, Jayson D.	n
Zaltz, Ira	3b – Pivot Medical; 5 – DePuy, a Johnson & Johnson Company
Zebala, Lukas P.	2, 6 – DePuy, a Johnson & Johnson Company; 6 – Medtronic Sofamor Danek, AO Spine/Omega
Zeft, Andrew	4 – Merck, Norvartis
Zellner, Benjamin S.	n
Zhang, K.	n
Zhang, Li-Quan	n
Zhou, Hanbing	n
Zuckerman, Joseph	1 – Exactech, Inc.; 4 – Hip Innovation Technology, Neostem; 6 – Orthonet; 7 – SLACK Incorporated, Wolters Kluwer Health – Lippincott Williams & Wilkins; 9 – American Orthopaedic Associationr

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Revised 06-10-13
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