Aspirin: An Alternative for Pulmonary Embolism Prophylaxis Following Arthroplasty

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Introduction: The most effective agent for prophylaxis against venous thromboembolic disease (VTE) following total joint arthroplasty (TJA) remains unknown. The paucity of literature comparing the different methods of pulmonary embolus (PE) prophylaxis and fear of litigation make it difficult for surgeons to abandon the use of aggressive chemical prophylaxis. The purpose of our study is to compare the outcomes of a consecutive group of patients undergoing TJA that received aspirin or warfarin prophylaxis.

Materials and Methods: There are 28,923 patients in the database who underwent TJA between January 2000 and June 2012. 2,800 received aspirin (325 mg twice daily) as prophylaxis against VTE while 26,123 received warfarin. The incidence of PE, deep vein thrombosis, hematoma formation, infection, wound complications and mortality up to 90 days postoperatively was collected from a prospectively maintained database. A multivariate analysis and propensity score matching for comorbid and demographic variables were performed.

Results: Overall PE rate in patients receiving aspirin at 0.14% was significantly lower than the overall PE rate of 1.07% among patients receiving warfarin. This difference did not change after a multivariate analysis, a 3:1 and 5:1 propensity score matching. The aspirin group had also significantly less DVT and wound related problems. Hospital length of stay was longer for patients receiving warfarin.

Discussion: Following publication of AAOS guidelines, some surgeons have utilized aspirin as a prophylaxis following TJA. Based on the findings of this study, it appears that aspirin is superior to warfarin in preventing pulmonary embolus following joint replacement and results in lower rates of DVT and wound complications.

Notes:
across Geisinger Health System using real-world electronic health record (EHR) data.

**Methods:** All patients (N=2,893) who underwent hip or knee TJA, identified with at least one of the procedure codes (TKA 81.54, 27130; THA 81.51, 27130, 27132; Other Hip: 81.47, 81.52, 81.53, 84.56, 84.57, 27488, 27090-27091, 00.85-87, 00.70-77), from 2008-2011, were captured from the de-identified EHR-based data extract of Geisinger Health system, under Medmining license. Readmissions within 90 days of discharge from the initial admission were identified by a combination of the encounter data diagnoses and financial billing codes. A multivariable logistic regression model with adjustments of covariates included the baseline patient-level surgical risk factors and hospital characteristics.

**Results:** The overall 90-days readmission rate in TJA was 6.8% (TKA: 5.6%; THR & Other Hip: 8.9%), consistent with the rates reported in the literature. The most common causes of readmission remain surgical/medical complications related to infection/inflammation of device/graft (25%), arthropathies/musculoskeletal (19%), cardio-pulmonary condition (12%), inpatient health services for specific procedures (8%), and other bacterial diseases (4%). After adjusting for confounding factors, 90-day readmission was significantly associated with delay from admission to surgery, history of myocardial infarction, obesity (BMI > 30 or ICD9: 287/278/V85.3), ASA scores (≥3), and procedure type (hip/knee).

**Discussion and Conclusion:** Infection/inflammation, cardiopulmonary complications and musculoskeletal complaints are the most common causes of readmission after TJA. Recognition of the identified risk factors may lead to employment of risk-mitigating strategies to potentially reduce readmissions.

**Notes:**

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**Intraoperative Fluoroscopy Does Not Improve Component Positioning in Total Hip Arthroplasty (THA): Findings from a High Volume Institution Degeneration**

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**Introduction:** Accurate component placement is imperative for successful outcome after THA. Although technology-assisted techniques offer potential for greater accuracy in prosthesis positioning, the need for additional resources prevents their widespread use. The objectives of this study were to compare primary THA procedures performed with and without intraoperative fluoroscopic guidance with regards to accuracy of prosthesis placement, operative times, and postoperative complications.

**Methods:** We reviewed 341 consecutive cases in 330 patients undergoing primary THA at our institution from September 2007 to January 2010. Postoperative AP radiographs were used to measure acetabular inclination angle, leg length discrepancy (LLD), and femoral offset discrepancy. Operative times and postoperative complications related to implant positioning were recorded. The control cohort underwent THA without fluoroscopic guidance and had 43% males, mean age of 64.6 years, and mean BMI of 29.6 kg/m2. The study cohort underwent THA with fluoroscopic guidance and had 49% males, mean age of 63.9 years and mean BMI of 28.9 kg/m2.

**Results:** Mean acetabular inclination angle, LLD, and offset discrepancy for the control vs. study groups were: 43.0° (range 32.2°-61.4°) vs. 43.8° (range 29.0°-55.1°), 4.75 cm (range 0–25) vs. 4.24 cm (range 0–27), and 8.47 cm (range 0–9.7) vs. 7.70 cm (range 0–31), respectively. Complication rates were not significantly different between the control (8.1%) and study (5.3%) groups. Mean operative time was significantly higher in the study group compared to the control group (59.8 vs. 52.8 minutes).

**Conclusion:** While the risks of THA failure due to component malpositioning are well noted, our study indicated intraoperative fluoroscopy may not improve prosthesis accuracy or decrease postoperative complication rates com-
pared to a freehand technique. Because of significantly increased operative time and costs associated with fluoroscopic guidance, we discourage the use of this technique in uncomplicated primary THA at high volume arthroplasty institutions.

Notes:

Clinical and Morphologic Factors Associated with Suture Anchor Refixation of Labral Tears in the Hip

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Introduction: The acetabular labrum is critical to hip function. It can be damaged by abnormal bony morphologies such as femoroacetabular impingement (FAI). Surgical options for treatment of a damaged labrum include removal, debridement, and refixation using suture anchors. Recent literature favors refixation with suture anchors due to better outcomes. Studies suggest this is due to the labrum’s ability to heal by ways of fibrovascular scar tissue to the acetabulum. The purpose of this study is to determine if certain patient demographic and osseous morphological factors result in increased labral damage requiring suture refixation.

Methods: Data was collected prospectively from a consecutive series of 334 procedures performed from August 2010-June 2011 for FAI. Demographic data, including age, sex, and race, was collected from patient charts. 3D CT scans were reviewed to retrieve alpha angles, acetabular version, femoral version and lateral center edge angle on the symptomatic hip.

Results: In 238 (71.3%) of the procedures, the labrums required refixation using suture anchors with a mean of 2.74 anchors being used. 78.8% of males required suture anchors and 62.3% of females required suture anchors. Among procedures requiring suture anchors, significantly more suture anchors were used in males (2.92) than females (2.47). Regression analysis showed a positive association between alpha angle, acetabular retroversion at 1 and 2 o’clock, and the number of suture anchors used. The mean alpha angle in the cohort that required suture anchors (63.1°) was significantly greater than the cohort that did not (59.4°).

Discussion and Conclusion: This study found femoral deformities to contribute more to labral damage than acetabular deformities and highlights the importance of preoperative 3D CT scans. This study provides demographic and morphologic factors to review preoperatively to evaluate if extensive labral damage is present and if ultimately, suture anchor refixation will be required.

Notes:

Aspirin May Be Adequate for Prevention of Thromboembolic Events Following Revision Total Joint Arthroplasty

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Introduction: The increased risks of venous thromboembolic disease (VTE) and wound complications associated with revision TJA may influence the choice of agent for chemical VTE prophylaxis. The goal of our study was to determine whether large differences in complication rates existed in patients receiving aspirin or warfarin for VTE prophylaxis after revision TJA.

Materials and Methods: We retrospectively reviewed a consecutive cohort of 223 revision TJAs. 137 patients received aspirin and 86 received warfarin for VTE prophylaxis. Univariate analysis was used to assess whether the VTE prophylaxis agent influenced risks of symptomatic VTE, bleeding, wound healing complications, and infection.
Results: The incidence of symptomatic VTE was 0.7% in patients receiving ASA, compared to 5.8% for patients receiving warfarin. The incidence of major bleeding was lower (3.6%) in the ASA group than the warfarin group (5.8%). The rate of wound complications at 10.2% and infection at 3.6% was lower in the ASA cohort, compared to 14.0% and 4.7%, respectively, in the warfarin group. Due to the small sample size, none of these differences reached statistical significance. With the observed effect size and power analysis, a minimum of 338 patients would be needed to avoid type II error for risk of VTE and 2436 patients for major bleeding.

Conclusions: The findings of this study reveal that aspirin may be an acceptable prophylaxis following revision TJA as the incidence of symptomatic VTE events does not seem to be substantially higher in the cohort that received aspirin compared to those who received more aggressive prophylaxis. Revision TJA patients are at increased risk of bleeding, and agents that are effective against VTE without causing increased bleeding would be a desirable choice in this patient cohort. The findings of this study are compelling enough to warrant further investigations.

Notes:

Synergistic Effect of a Multimodal Approach to Blood Management After Total Hip Replacement

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Introduction: There is a substantial risk of transfusion after total hip arthroplasty (THA). For several years we have utilized a preoperative blood conservation program (BCP) to lower this risk. We recently began using IV tranexamic acid (TEA) to further minimize the risk of transfusion. The purpose of this study is to determine if a combination of these approaches could synergistically decrease the risk of transfusion.

Methods: We identified 254 consecutive primary THA patients treated during 2012. 123 patients participated in the BCP where they were given erythropoietin, iron or dietary recommendations based on Hgb levels. 215 patients were treated with tranexamic acid. Patients were stratified according to which interventions they received. Group 1 consisted of 73 patients who participated in the BCP and received TEA. Group 2 had 50 patients that participated in the BCP but did not get TEA. Group 3 was 142 patients that got TEA, but did not participate in the BCP. Group 4 was 19 patients that did not do the BCP and had no TEA. Transfusion rates were assessed for all groups.

Results: There were a total of 25 transfusions (9.8%). There were 3 transfusions in group 1 (4.11%). There were 5 transfusions in group 2 (10.0%). Group 3 had 13 transfusions (9.2%), and group 4 had 4 transfusions (21.0%).

Discussion and Conclusion: Both BCP and TEA decreased by half the incidence of transfusion compared to no intervention. However, the combination of BCP and TEA produced a synergistic effect, lowering the incidence of transfusion further than either intervention did on its own. The combined use of these tools could make transfusion a rare event for THA patients.

Notes:

Migration and Thigh Pain with a New Short Modular Femoral Stem for Total Hip Replacement

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Introduction: Short femoral stems are receiving increasing attention for less invasive total hip replacement (THR). The purpose of this study is to report our initial experience with a short modular femoral (SMF) stem at a minimum two-year follow up.

Methods: Twenty-six primary total hip arthroplasties (THAs) using the SMF stem were performed between August 2009 and January 2010. Patients were evaluated
clinically with Harris Hip Score (HHS) and radiographically up to two years. Radiographs were analyzed to determine the degree of stem migration from its initial postoperative position. These parameters were compared to those of a cohort of 54 patients implanted with a monolithic tapered wedge stem from the same manufacturer over the same time period.

Results: There were three early revisions of the femoral component for thigh pain in the SMF group, and one revision for CoCr allergy, with improvement in HHS from 60 to 89. Radiographically, 20 of 26 stems (76%) migrated into varus in the first six weeks. Of these, eight patients (29.6%) reported moderate to severe thigh pain. Radiographic evidence of isolated lateral cortical hypertrophy at the stem tip was seen in 46% of study patients, and evidence of osteointegration was seen in all cases by one year. Between one and two years post op the pain had resolved in four patients not revised. It was persistent in one patient. Comparative analysis with the control group demonstrated no significant difference in stem subsidence, but a significantly greater varus shift in coronal-plane angulation (Mean 4.3°, SD 3° vs. Mean 1.0°, SD 1.1°; p < 0.0001). Mean HHS was lower in the SMF group (85.2 vs. 91.4; p<0.01) at last follow up.

Discussion and Conclusion: The SMF stem demonstrated a tendency towards migration into a varus position where the lateral stem touches the lateral cortex of the femur, resulting relatively higher incidence of thigh pain and early aseptic revision.

Notes:

Multimodal Pain Management: An Unexpected Benefit

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Introduction: Elevated temperatures following total joint arthroplasty (TJA) are not uncommon and can be a source of anxiety for both the patient and the surgical team. Although this is rarely a result of acute infection, many patients are subjected to extensive work-up. We recently implemented a multimodal pain management regimen for TJA which includes acetaminophen, pregabalin, and celecoxib or toradol. The hypothesis of this study was that patients subjected to this protocol are less likely to exhibit postoperative fever after primary TJA.

Methods: 1,627 patients undergoing primary TJA and receiving opioid pain medication alone were compared to 2,660 patients receiving multimodal agents. Oral temperature readings in the first five postoperative days were collected and charts were reviewed for fever work-up tests, including urinalysis, urine culture, chest x-ray and blood culture. Fever was defined by the presence of a temperature measurement over 101.4°F. Patients having preoperative fever or postoperative fever starting later than postoperative day 5 were excluded.

Results: The 2 groups had comparable preoperative temperature measurements. The average midnight temperature response was significantly lower in the multimodal analgesia group and only 4.5% of patients developed postoperative fever, compared to 25.4% in the opioid-alone group. Furthermore, there was a significant decrease in the number of cases undergoing work-up for fever in the multimodal analgesia cohort (1.8% of cases undergoing 155 individual tests), compared to the opioid cohort (9.8% of patients undergoing 247 individual tests).

Discussion and Conclusion: In addition to fewer adverse effects and better pain control, the multimodal analgesia protocol has the hidden benefit of dampening the temperature response to the surgical insult of TJA. The decreased rate of postoperative fever avoids unnecessary anxiety for the patient and the treating team, and reduces healthcare resource utilization occasioned by working up postoperative fever.

Notes:
Introduction: A comprehensive synovial fluid biomarker program has recently identified alpha-defensin, an antimicrobial peptide, as a highly accurate biomarker for diagnosis of PJI. The purpose of this study is to evaluate the clinical performance of alpha-defensin, and compare it to the performance of the recently described leukocyte esterase (LE) colorimetric test strip.

Methods: Synovial fluid was prospectively collected from patients during evaluation for revision hip or knee arthroplasty. Using the MSIS criteria, 23 patients were classified as infected while other 23 patients had aseptic failure. All synovial fluid samples were tested with both a novel synovial-fluid-optimized immunoassay for alpha-defensin and the LE colorimetric test strip.

Results: The synovial fluid alpha-defensin immunoassay correctly predicted presence or absence of PJI demonstrating a sensitivity and specificity of >98% for the diagnosis of PJI. The average alpha-defensin concentration among infected samples was 59,604ng/ml, which was 60-fold higher than the average level among aseptic samples (986ng/ml). The leukocyte esterase test strip could not be interpreted in 8 of 46 samples (17%) due to blood interference, yielding a best-case scenario of 78% sensitivity and 100% specificity, and a worst-case scenario of 60% sensitivity and 96% specificity.

Discussion: Based on the findings of this study alpha-defensin immunoassay of synovial fluid was found to be a promising biomarker for diagnosis of PJI. This biomarker appears to overcome the issue with blood stained fluid that precludes the use of LE strips.
The animals were sacrificed at six weeks post-operatively and femurs harvested. Fracture healing was analyzed using histology and radiography.

**Results:** The experimental groups demonstrated excellent conduction of new bone formation compared to controls. The results were evident on radiographs and histology. Histology showed Group 1 controls to have 11.1% new bone formation, 37.8% for group 2, and 49.2% for Group 3. These results were statistically significant. Of note, the amniotic membrane group, showed near complete bridging of the gap with pronounced periosteal woven bone formation.

**Discussion and Conclusions:** The study demonstrates that amniotic membrane products have potential to provide bridging of bone defects. The ability to fix large bone defects without harvesting autogenous bone would provide a significant improvement in patient care.

**Notes:**

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**Resident/Fellow Award Winner**

**An In Vitro and In Vivo Investigation of Annulus Fibrosus Cell “Stemness”: A Potential Pathogenesis of Disc Degeneration**

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**Introduction:** Low back pain is an endemic problem and is associated with intervertebral disc degeneration. Cartilage, bone, and nerve tissues exist and worsen the degenerated disease. The goal is to investigate the hypo-chondrogenic, osteogenic, and vessel formation of the annulus fibrosus (AF) tissue in two in vivo models.

**Methods:** Rabbit AF cells were cultured under chondrogenic and osteogenic condition, and characterized with RT-PCR, histology, and immunostaining. Two models were used in vivo experiments: subcutaneous implantation of the rabbit AF tissue in a demineralized bone matrix (DBM) cylinder, and subcutaneous implantation of needle punctured intervertebral discs from male rats to female nude mice. The specimens were evaluated with radiograph, histology and immunostaining at different time points.

**Results:** In a pellet culture system, rabbit AF cells expressed significant higher amount of collagen and aggrecan in mRNA and protein levels under chondrogenic than control medium. With osteogenic induction, the cells exhibited increased mineralization and expression of osteogenic markers e.g. osteopontin, Runx2, and BMP2. Four weeks after implantation of DBM/AF, bone formation in AF was detected by radiograph, histology, and immunostaining of osteocalcin, which increased at 8- and 12-week. Safranin-O and H&E staining confirmed the hypo-chondrocytes and osteoblasts. Collagen I, II, X, and osteocalcin expressions were observed in AF/DBM specimens 8 weeks after implantation. Only collagen II was detected in AF tissue without DBM. The similar phenomenon was observed in needle punctured discs. The vessel formation was detected in the inner region of injured discs by isolecitin B4. Up to 6 months, almost all the discs turned into bone tissues.

**Conclusion:** Rabbit AF cells differentiate to different cells under specific stimuli. The characterization of these stem cells will provide a new tool in the study of disc biology and build a foundation for future corresponding therapies, which could include targeting stem cell stabilization or maintaining the capability of cells for undifferentiated self-renewal.

**Notes:**
Is There a Chondroprotective Effect of Autologous Protease Inhibitor Concentrate (APIC) in an Osteoarthritis (OA) Rabbit Model?

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Introduction: The pathology of osteoarthritis is known to involve the upregulation of inflammatory mediators and catabolic factors such as matrix metalloproteases (MMPs). Alpha-2-macroglobulin (A2M) is a naturally-occurring plasma glycoprotein that functions throughout multiple tissues and extracellular spaces as a protease inhibitor but does not normally reach high levels within the intra-articular joint space. A2M is believed to modulate cartilage catabolism by its ability to bait, trap and clear various MMPs and may modulate immune responses via a binding site for growth factors and cytokines. This investigation tested the hypotheses that intra-articular administration of APIC in a rabbit model of post-traumatic arthritis will attenuate progression of cartilage damage and modulate cytokine response in the synovial fluid.

Methods: New Zealand White rabbits underwent a blood draw that was immediately processed to produce an autologous protease inhibitor concentrate (“APIC”) that contains a supraphysiological concentration of alpha-2-macroglobulin (A2M). Transection of the anterior cruciate ligament (ACL) was performed to accelerate OA development. The rabbits were divided into two groups. The treatment group (N=6) was administered 3 autologous doses of APIC at 1, 4 and 14 days post-surgery while the control group (N=6) received no treatment post-surgery. Rabbits also received sham surgery on the contralateral knee. At the end of 6 weeks animals were sacrificed and knees were processed and analyzed for gross and histologic pathology. Cartilage pathology was evaluated by macroscopic and histologic examination of the femoral condyles and tibial plateaus using the OARSI grading scale.

Results: 12 rabbits underwent ACL-T, 6 in each group. Macroscopic evaluation of the femur and tibia demonstrated that application of APIC reduced cartilage degradation by 53.2% compared to untreated controls. The concentration of α-2-Macroglobulin (A2M) in the APIC varied from 5 – 65 mg/ml. There was a dose-dependent correlation between higher concentrations of A2M in the APIC and decreased OARSI total knee score on the macroscopic evaluation. There was also a dose-dependent therapeutic benefit to APIC treatment observed in sum OARSI histopathology evaluations of Safarin-O staining, Structure, Chondrocyte density, and Cluster Formation.

Conclusions: This pilot study suggests that 3 injections of APIC starting 24 hours after the intra-articular injury may prevent cartilage catabolism in an animal model of OA, and may provide chondroprotective effects following injury. This activity may be explained by the increased concentration of A2M in APIC over its physiologic concentration in blood. This conclusion is in agreement with our in-vitro and ex-vivo experiments that demonstrate the chondroprotective effect of A2M on cartilage.

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analyzed using an administrative database that included 325 30-day readmission cases and 13,338 non-readmission cases, for orthopaedic patients admitted during the September 2008 to April 2011 time period. Each patient’s zip code provided a surrogate for income, using median household income values for each zip code from 1999 US Census data. The patients were divided into quintiles based on income. Co-morbidity was categorized by combining groups of DRG-based classifications into 3 classifications: no co-morbidities, minor co-morbidities, or major co-morbidities. Risk factors were analyzed for readmission using a Bayesian logistic regression model. Differences in readmission rate for co-morbidity categories were analyzed using the chi-square test.

**Results:** There were 1272 unique zip codes in the analyzed patient population, with median incomes ranging from $6,450 to $189,763. The regression model found a significantly increased risk of readmission for LOS (OR = 1.45, p < 0.0001), minor co-morbidities (OR = 1.74, p < 0.0001) and income quintile 4 ($32,303-$42,374, OR =1.46, p=0.04). The reference income range was $70,101-$189,763 (quintile 1). The proportion of patients readmitted was significantly different across co-morbidity categories (p < 0.0001). There was a 126% increase in the readmission rate when comparing patients with no co-morbidities to those with major co-morbidities (p < 0.0001).

**Conclusion:** These data suggest that LOS and co-morbidity status are primary risk factors for orthopaedic readmission. Socioeconomic status had a moderate impact on risk, with patients of low-mid income having a significantly higher risk of readmission. A limitation of our analysis is that zip code-level income may measure area-level effects (e.g. neighborhood resources) more so than individual socioeconomic status.

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**Olecranon Tip Osteoarticular Autograft Transfer for Irreparable Coronoid Process Fractures: A Biomechanical Study**

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**Introduction:** Coronoid process fractures are common in traumatic elbow injuries. With extensive fracture comminution, few options exist for reconstruction. The olecranon tip, being morphologically similar to the coronoid, may be a suitable option for reconstruction. We evaluated the suitability and biomechanics of an olecranon tip transfer for type III coronoid fractures.

**Materials and Methods:** Six fresh-frozen cadaveric elbows were tested. All soft tissues were removed, leaving the collateral ligaments intact. The coronoid process was osteotomized to create a type III fracture model and subsequently reconstructed using the appropriate amount of olecranon process. The elbows were mounted on a custom jig on an MTS load frame and an axial load of 100N was applied to the elbows at 15mm/min in 15-degree intervals from 0 to 120 degrees of flexion. Posterior ulnohumeral displacement was obtained using crosshead motion data in each of 3 configurations: 1. intact coronoid; 2. osteotomized coronoid; 3. olecranon transfer. Elbow range of motion was compared between the intact and reconstructed states. A paired t-test was used to compare differences in posterior displacement between the osteotomized and reconstructed states.

**Results:** Maximum ulnohumeral translation was seen between 30 and 105 degrees of flexion. Type III coronoid fracture increased posterior humeral translation over the control by an average of 63% during this range of motion arc (range, 23-143%)). Olecranon tip transfer reduced posterior ulnohumeral translation to 4% over the intact state (range, -4- 30%)(p<0.05). No statistical differences in the reconstructed versus intact groups were seen between 30 and 105 degrees. The transfer was a near anatomic fit in every trial.

**Conclusions:** Autograft osteoarticular olecranon tip transfer for type III coronoid fractures can restore elbow stability during axial loading without compromising elbow range of motion.
motion This is a promising, novel option for patients with irreparable coronoid fractures.

Notes:

Unexpected Dispensable Role of MMP9 in a Stabilized Femur Fracture Model

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Purpose: Previous research has identified MMP-9 as a key regulator of fracture healing. However, these studies were conducted in a closed, non-stabilized murine tibia fracture model. To determine if MMP-9 remained indispensable in promoting fracture angiogenesis in a more clinically relevant model, we utilized a murine stabilized transverse femoral fracture and compared key aspects of fracture healing, with emphasis on vascularity, in mice with and without MMP-9. We hypothesize that MMP-9 would also prove to be essential for fracture healing in a stabilized femur fracture model.

Methods: We used an open femur fracture model on wild type(WT) and MMP-9 deficient(MMP-9 KO) mice. Fracture healing was followed radiographically at 7, 10, 14 and 21 days post-fracture(dpf). Mice were sacrificed at 7,10,14 and 21 dpf and were injected with radio-opaque Microfil. 3D-vascular reconstruction was achieved by using uCT. Using histology, we then measured cartilage(CA) and total-callus area(TA) with which a ratio was produced, CA/TA(mm2). Students T-Test was used for evaluation of statistical significance between groups.

Results: Both WT(n:17) and MMP-9KO(n:21) mice displayed similar fracture healing radiographically. At each end point, there were no statistically significant differences of CA/TA ratio in WT and MMP-9KO mice by examining with Saf-ranin-O staining. Vascularity in the calluses of MMP-9KO mice seemed similar to that of WT mice.

Conclusion: Despite previous reports, we found that a loss of MMP-9 resulted in no significant differences in the development of soft tissue callus or vascular invasion and subsequent development and remodeling of hard tissue callus in a stabilized femur fracture model. We hypothesize that this difference is due to two potential mechanisms: 1) stabilization of the fracture, 2) differences in the vascularity of the femur as opposed to the tibia, suggesting that MMP-9 is essential only in a fracture with a relatively reduced initial vascular supply. These results highlight the potential differing results of various employed fracture models.

Notes:

Biomechanical Contribution of Transverse Connectors in the Setting of a Thoracic Pedicle Subtraction Osteotomy

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Introduction: Little data is available to guide longitudinal construct planning after a pedicle subtraction osteotomy (PSO) in the thoracic spine. Previous investigations have suggested the role of transverse connectors (TC) in enhancing torsional rigidity following long segment thoracic pedicle screw-rod instrumentation. However, the biomechanical effect of augmentation with one or two TC after PSO in the thoracic spine has not been previously evaluated.

Methods: Seven (7) fresh-frozen human cadaveric thoracic spines (T3-T11) were prepared, maintaining all osteoligamentous structures, and intact range of motion testing was performed with non-destructive loading (±6 Nm) in a six-degree-of-freedom spine simulator. The specimens were then instrumented from T4-T10 with bilateral 5.5-mm polyaxial titanium pedicle screws and 5.5-mm contoured rods, and then a PSO performed at T7. Range of motion was subsequently analyzed in the unaugmented construct, with 1 TC (T8-T9) and then 2 TC (T5-T6 and T9-T10). Range of motion (ROM) was analyzed in axial rotation, flexion-extension, and lateral bending loading planes over T4-T10 and at the PSO level (T6-T8),
using a repeated measures ANOVA with Sidak correction for multiple comparisons.

**Results:** After PSO and instrumentation with a thoracic pedicle screw-rod construct, T4-T10 ROM was significantly reduced in all planes of motion from the intact condition (p<0.05). In contrast, during axial rotation, T4-T10 ROM was reduced by 43% following addition of 2 TC (p<0.05), but did not reach statistical significance. Focal segmental stability (T6-T8) at the PSO level had similar improvement in axial rotation stability following the addition of transverse connectors, with a 48% decrease in axial rotation after 2 TC (p<0.05).

**Discussion and Conclusion:** Two transverse connectors (cross links) improved torsional rigidity by 43%, with no differences in stability for all planes of motion over the use of one transverse connector. Therefore, in the setting of a PSO and long segment pedicle screw-rod construct, augmentation with at least two transverse connectors improves torsional rigidity.

**Notes:**

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**Incidence and Long-Term Outcome of Nonsurgical Management of Displaced Oblique Shaft Fractures of the Fifth Metatarsal (Dancer’s Fracture)**

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**Introduction:** Non-operative management has been the preferred treatment for displaced oblique spiral fractures of the distal shaft of the fifth metatarsal bone (dancer’s fracture). While it is assumed that non-operative treatment results in satisfactory functional outcome, a paucity of literature supports this claim. The purpose of this investigation is to report the incidence and long-term outcome in the largest cohort of dancer’s fractures reported to date.

**Methods:** From 2005-2010, 2990 patients sustaining metatarsal fractures were seen and treated at our institution. A retrospective review was conducted to identify fractures described as displaced oblique spiral fractures of the distal shaft of the fifth metatarsal. All identified cases were confirmed by radiographs. All patients were treated non-operatively, weight bearing as tolerated in a hard soled shoe for 8 weeks with transition to normal footwear when clinically asymptomatic. Initial follow up was conducted at 6 and 12 week intervals. Afterwards, long-term follow-up was conducted, demographic information was obtained, and the SF-12 and Foot and Ankle Ability Measure (FAAM) were administered. For all patients in this study, there was a minimum of two year follow-up.

**Results:** 141 new dancer’s fractures occurred from 2005-2010 for an incidence of 4.72%. Average follow up was 3.5 years. There were 116 females and 25 males, average age 55. FAAM activities of daily living subscale scores averaged 93.22 (±12.12), while FAAM sports subscales were 92.92 (±16.58). SF-12 physical and mental scores averaged 52.42 (±8.17) & 50.67±6.35 respectively.

**Discussion and Conclusion:** This large cohort describes the incidence, natural history, and functional outcomes of displaced oblique fracture of shaft of the fifth metatarsal bone. Most importantly, non-operative management of these fractures results in excellent, long-term functional outcomes.

**Notes:**
Outcomes After Total Ankle Replacement in Association with Ipsilateral Hindfoot Arthrodesis

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Mark E. Easley, MD

Introduction: Ipsilateral hindfoot arthrodesis in combination with total ankle replacement (TAR) may diminish functional outcome and prosthesis survivorship compared to isolated TAR. We compare the outcome of isolated TAR to outcomes of TAR with ipsilateral hindfoot arthrodesis.

Methods: In a consecutive series of 404 primary TARs in 396 patients, 70 (17.3%) had a hindfoot fusion before, after, or at the time of TAR; most had either isolated subtalar arthrodesis (n=43; 62%) or triple arthrodesis (n=15; 21%). The remaining 334 isolated TARs served as the control group.

Results: Mean patient follow-up was 3.2 years (range, 24-72 months). The SF-36 total and subscales, AOFAS hindfoot-ankle pain subscale, Foot and Ankle Disability Index, and SMFA Function and Bother scores were significantly improved at the most recent follow-up after TAR compared to pre-operative assessment, with no significant differences between the hindfoot arthrodesis and control groups. The AOFAS hindfoot-ankle total, function and alignment scores were significantly improved at most recent follow-up for both groups; the control group demonstrated significantly higher scores in all three scales. The control group demonstrated a significantly greater improvement in VAS pain score when compared with the hindfoot arthrodesis group. Walking speed, sit-to-stand time, and four-square step-test time were significantly improved for both groups at each post-operative time point, albeit with the hindfoot arthrodesis group completing these tests significantly slower than the control group. Outcomes and implant survivorship were not significantly different between the two groups.

Discussion and Conclusion: To our knowledge, this study represents the first series evaluating the clinical outcome of TARs performed with and without hindfoot fusion using implants available in the United States. At midterm follow-up, TAR performed with ipsilateral hindfoot arthrodesis results in significant improvements in pain and functional outcome; in contrast to prior studies, however, overall outcome may be inferior to that of isolated TAR.

Notes:

The Effect of Platelet-Rich Plasma on Autologous Osteochondral Transplantation: An In Vivo Rabbit Model

Niall A. Smyth, MD
Amgad M. Haleem, MD
Christopher D. Murawski, BS
Huong T. Do
Jonathan T. Deland, MD
John G. Kennedy, MD, FRCS (Orth)

Background: Autologous osteochondral transplantation (AOT) restores a cartilage defect with a cylindrical unit of bone and articular cartilage. Previous studies have described poor graft integration at the chondral interface and degeneration of the cartilage. This has prompted the investigation of adjuncts to address these concerns, including platelet-rich plasma (PRP), which has the potential to improve chondral interface integration and decrease cartilage degeneration. The purpose of this study was to evaluate the effect of PRP on AOT in a rabbit model.

Methods: Bilateral osteochondral defects (2.7 mm in diameter, 5 mm in depth) were created on the femoral condyles of 12 New Zealand white rabbits. Osteochondral grafts were harvested from the ipsilateral femoral condyle and, after randomization, treated with either PRP or saline before implantation into the defect site. The rabbits were euthanized at 3, 6, and 12 weeks post-operatively. The osteochondral graft was assessed using the ICRS macroscopic and modified ICRS histological scoring systems.

Results: Macroscopic assessment revealed no statistically significant difference between the two groups (11.2 ± 0.9 vs. 10.3 ± 0.9). The mean modified ICRS histological score was significantly higher overall and at each time point for the PRP treated osteochondral transplants compared to the control (overall mean 18.2 ± 2.7 vs. 13.5 ± 3.3). Assessing graft integration specifically, the mean score for the PRP treated group was significantly higher compared to the control group (2.5 ±
0.9 vs. 1.6 + 0.7). No adverse events occurred as a result of the surgical procedure or PRP.

**Conclusion:** The results of this study show that PRP may improve the integration of an osteochondral graft at the cartilage interface and decrease graft degeneration in an in vivo model.

**Notes:**

Anterior Talofibular Ligament Abnormality on Routine Magnetic Resonance Imaging of the Ankle

Patrick Kane, MD
Adam C. Zoga, MD
Steven M. Raikin, MD
David I. Pedowitz, MD

**Introduction:** Injury to the anterior talofibular ligament (ATFL) is frequently encountered on magnetic resonance imaging (MRI) of patients with ankle sprains. However, abnormalities of the ATFL are also frequently seen as incidental findings when imaging the foot and ankle for other reasons. Previous studies have documented the prevalence of abnormal MRI findings in asymptomatic individuals in other areas of orthopaedics, most notably shoulder and spine. To our knowledge, no such investigation has been made with regards to the ATFL in the ankle. The purpose of this study is to determine the prevalence of abnormal MRI findings of the ATFL in asymptomatic individuals.

**Methods:** A total of 108 foot and ankle MRIs were eligible for inclusion in this study. Studies were excluded if performed on patients with documented ankle sprains or lateral ankle trauma. An attending musculoskeletal radiologist reviewed each MRI evaluating the integrity of the ATFL as well as confirming the primary pathology noted in the initial report. The ATFL was graded as either normal, chronically thickened, attenuated, chronically torn, or acutely torn.

**Results:** Of the 108 foot and ankle MRIs examined, only 42 had a normal appearing ATFL; 33 were chronically thickened, 28 were attenuated, and 23 were chronically torn. None were found to be acutely torn. The most frequently encountered primary pathology was Achilles tendinosis followed by plantar fasciitis.

**Discussion and Conclusion:** The results of this study demonstrate a large majority of patients undergoing MRI evaluation for alternative foot and ankle pathology have an abnormal ATFL. The results of this study may have important implications for clinical practice. Patient history and exam should be taken into careful consideration when reviewing the radiographic appearance of the ATFL, as treatment in asymptomatic individuals will likely result in continued dissatisfaction.

**Notes:**

Juvenile Allograft Cartilage Implantation for Treatment of Osteochondral Defects (OCDs) of the Talus

Dinesh Dhanaraj, MD
Mathew Hamula, BS
Robert Meislin, MD
Kenneth Mroczek, MD
Cary B. Chapman, MD

**Introduction:** To evaluate the outcomes of patients treated with particulated juvenile allograft cartilage implantation for osteochondral defects of the talus.

**Methods:** A total of thirteen patients with either 1) osteochondral lesions of the talus measuring at least 1 cm² (average 1.5 cm²) or 2) patients who failed microfracture underwent arthroscopic assisted implantation of graft into defects. All defects were secured with a fibrin sealant and patients postoperatively were restricted to non-weight bearing for six weeks. The median age at operation was 43.4 years (range 35-57). Patients were evaluated using physical examination, patient interviews, and pre and post-operative VAS, SF-36, FAAM and AOFAS scores. Patients had a minimum follow-up of 15 months (range 15-24 months).

**Results:** The average pre-operative pain score was 7.4 with reduction to 2.5 post-operatively. Similar improvements were seen in SF-36 scores with ten out of thirteen patients reporting good to excellent outcomes. Average pre-operative AOFAS score was 60 with an improvement to 85 post-operatively, and improvements were also seen in FAAM scores. All improvements were statistically significant (p=0.05).
Discussion and Conclusion: The treatment of osteochondral defects of the talus remains a challenge. Currently, a wide variety of options are available to surgeons without a clear-cut gold standard. To our knowledge, our study is the largest case series to date. We advocate the use of arthroscopic assisted implantation of talar OCD lesions as a highly effective single procedure treatment modality.

Notes:

Clinical and MRI Outcomes Following Arthroscopic Microfracture of Osteochondral Lesions of the Distal Tibial Plafond

Keir A. Ross, BS
Charles P. Hannon
Niall A. Smyth, MD
Hunter Newman
Timothy W. Deyer
John G. Kennedy, MD, FRCS (Orth)

Introduction: Osteochondral lesions (OCLs) of the distal tibial plafond are uncommon compared to talar lesions. There is little evidence regarding the clinical outcomes of arthroscopic microfracture of tibial OCLs and there are no reports regarding the magnetic resonance imaging (MRI) findings in the literature. The treatment outlines that exist for talar lesions have not been established for tibial OCLs. The objective of this study is to present the results of the largest clinical case series and first MRI outcomes following arthroscopic microfracture of the distal tibial plafond in the literature to date.

Methods: 32 tibial OCLs in 31 patients (32 ankles) underwent arthroscopic microfracture. Additionally, 5 patients had a kissing lesion with an OCL on the opposing surface of the talus. The Foot and Ankle Outcome Score (FAOS) and Short Form-12 (SF-12) general health questionnaire provided patient reported outcome scores pre- and post-operatively. MRI scans were assessed post-operatively using the Magnetic Resonance Observation of Cartilage Repair Tissue (MOCART) score in 19 ankles.

Results: The mean follow-up for all patients was 35.5 months. The mean FAOS improved significantly from 53 points pre-operatively to 75 points post-operatively. The mean SF-12 scores also improved significantly from 40 points pre-operatively to 60 points post-operatively. Average lesion size was 36 mm² (range = 3.14 – 78.5). Average MOCART score was 67.9 and 59.5 in all tibial osteochondral lesions and tibial lesions with a reciprocating talar lesion respectively.

Discussion and Conclusion: This study confirms that microfracture is an adequate treatment strategy for OCLs of the distal tibial plafond, however the repair tissue as assessed on MRI reveals inferior tissue repair. Follow-up studies are required to evaluate long-term outcomes of distal tibia OCLs with arthroscopic microfracture.

Notes:

Mini-Incision Release Versus Extended Release with Neurolysis and Tenosynovectomy for Severe Carpal Tunnel Syndrome

Praveen G. Murthy, AB
Sidney M. Jacoby, MD
Abdo Bachoura, MD
Eon K. Shin, MD
A. Lee Osterman, MD

Introduction: There are few studies in the current literature addressing treatment options for severe carpal tunnel syndrome (CTS), as defined by electrodiagnostic studies showing non-recordable distal sensory latency of the median nerve. Our study aims to compare the efficacy of mini-incision carpal tunnel release versus extended release with neurolysis and tenosynovectomy in treating patients with severe CTS.
Methods: A retrospective review of patients who underwent primary carpal tunnel release for severe CTS was conducted. Patients were treated with either a mini-incision (2-cm) release of the transverse carpal ligament (group 1), or extensive release with neurolysis and tenosynovectomy (group 2), each by a single surgeon at our center from 2008-2011. Group 1 included 85 hands in 65 patients, while group 2 included 98 hands in 82 patients. Patients were evaluated based on pre- and post-operative grip strength as well as Boston Carpal Tunnel Questionnaires, with an average follow-up of 40.0 months in group 1 and 40.5 months in group 2.

Results: On average, grip strength increased by 37.3% in group 1 and 42.4% in group 2, yielding no significant difference between the two groups (p=0.829). Post-operatively, patients in the mini-incision cohort reported an average BCTQ symptom severity score of 12.38 (out of 55) and functional status score of 8.63 (out of 40). In the extended release cohort, average scores were 12.88 and 9.06, respectively. There was no significant difference in postoperative symptom severity or functional scores between the two groups (p=0.589 and p=0.482, respectively). One patient in the mini-incision cohort required revision surgery after two years.

Discussion and Conclusion: Mini-incision carpal tunnel release and extended release with neurolysis and tenosynovectomy are both effective treatment options for severe carpal tunnel syndrome. Our study found no significant differences between the two procedures with regard to patient-rated symptom severity or functional status outcomes.

Notes: 

The Association of Metabolic Syndrome Markers with Adhesive Capsulitis

Min Jung Park, MD, MMSc
*Itai Gans, BS
Daniel C. Austin, BA
James L. Carey, MD, MPH
John D. Kelly IV, MD

Introduction: Research has associated adhesive capsulitis with diabetes mellitus, but suggests that glucose mediated injury may begin before diabetes is diagnosed. The period preceding diabetes is often marked by the metabolic syndrome. We studied the relationship between metabolic syndrome components (insulin resistance, hypertension, dyslipidemia, and obesity) and the development of adhesive capsulitis.

Methods: We retrospectively reviewed 150 consecutive adhesive capsulitis patient charts to determine the prevalence of obesity and use of medications for treating metabolic syndrome elements. We compared this data to previously reported baseline values from nationwide surveys. Ninety-five percent confidence intervals for all prevalence values allowed the groups to be effectively compared.

Results: The overall prevalence of diabetic medications in adhesive capsulitis patients was 18.4% [95% CI 12.9-25.7], twice the national rate of diagnosed diabetes of 7.6% [95% CI 6.7-8.5]. In the 20-39 year old age group, the prevalence of diabetic medications in the adhesive capsulitis group, 26.3% [95% CI 11.8-48.8], was over 10x the nationwide rate. The overall prevalence of hypertensive medications in the adhesive capsulitis group, 33.1% [95% CI 25.9-41.2], was notably higher than the nationwide rate, 21.6% [95% CI 19.8-23.4]. In the 40-64 year old age group, the prevalence of hypertensive medications in adhesive capsulitis patients, 36.8% [28.6-46.0], was notably higher than nationwide rates of 24.5% [95% CI 22.2-27.0]. The prevalence of lipid medications and obesity were similar between the two groups.

Discussion and Conclusion: Our results confirm that diabetes is strongly associated with adhesive capsulitis with dramatically higher rates of the disease observed within these patients. Higher rates of hypertension medications in patients with adhesive capsulitis suggest that hypertension may also be associated with the disease. Dyslipidemia and obesity do not appear to be associated with adhesive capsulitis. Further prospective studies are necessary to fully elucidate the relationship between metabolic syndrome and adhesive capsulitis.

Notes: 

12:26pm–12:32pm
Arthroscopic Treatment of Anterior Shoulder Instability in Contact and Noncontact Athletes

Kevin D. Plancher, MD
Stephanie C. Petterson, MPT, PhD
Monet France, MD

Introduction: The success of arthroscopic repair for anterior shoulder instability rivals that of open repair. Arthroscopic repair yields improved arc of motion and function with minimal insult to the subscapularis in the overhead athlete, yet controversy still exists for the collision/contact athlete. The purpose of the study is to prospectively evaluate arthroscopic inferior capsular shift with suture anchors in contact and noncontact athletes.

Methods: 61 consecutive patients underwent treatment for anterior instability with arthroscopic-modified, inferior capsular shift from 1999 to 2009 by 1 orthopaedic surgeon. Inclusion criteria were traumatic, recurrent dislocation (≥2 or more), labral detachment from 12-6 o’clock, non-engaging Hill-Sachs lesion, and a minimum follow-up of 2 years. Patients completed the WOSI, MISS, Rowe, Constant-Murley, and Simple Shoulder Test and underwent physical examination. Data were analyzed with repeated measures ANOVA with significance level of 0.05.

Results: 21 athletes (Nmale=15, Nfemale=6; mean age=34±10 years) met the inclusion criteria (Ncontact=13, Nnoncontact=8)(mean follow up=3.8±3.2yrs). One failure occurred at 10 months and another at five years. 97% returned to sports at an average of 5.1 months (contact=5.4 months, non-contact=4.7 months, p>0.05); 86% returned at their preoperative performance level. There were no differences between contact and noncontact athletes on any outcome measure. Significant improvement in function was found on all shoulder scoring systems. Flexion ROM significantly improved post-operatively to 174.5°±5.59° (p=0.012). There was a trend towards improved postoperative ABD ROM (174.5°±5.5°) (p=0.06). ER was maintained postoperatively (91.7°±10.6°; p=0.18). Internal rotation significantly improved from T12/L1 to T9 postoperatively (p=0.002).

Discussion and Conclusion: Contact and non-contact athletes exhibited similar outcomes following modified inferior capsular shift for anterior shoulder instability with significant improvement in ROM and return to sport following surgery.

Arthroscopic stabilization should be considered for contact and non-contact athletes undergoing treatment in anterior instability without an engaging osseous defect.

Notes:

MRI Findings in Acute Elbow Dislocation: Insight into Mechanism

Joseph J. Schreiber, MD
Hollis G. Potter, MD
Russell F. Warren, MD
Robert N. Hotchkiss, MD
Aaron Daluiski, MD

Introduction: The deforming forces and mechanism of elbow dislocation are not entirely understood, with the relative contribution and sequence of ligamentous disruption still in question. The purpose of this MRI study was to catalog the incidence and location of ligamentous disruption following acute elbow dislocation.

Methods: Blinded post-dislocation MRI images of 16 patients were assessed for signal intensity and morphology of the anterior (AMCL) and posterior (PMCL) bands of the anterior bundle, the lateral ulnar collateral ligament (LUCL) and the radial collateral ligament (RCL). Distinction was made between intact ligaments, low-grade partial tear (<50% of the ligament), high-grade partial tear (>50%) and full thickness disruption. Chi-squared test assessed the association between location and severity and Fisher’s exact test compared injury frequency across sites.

Results: Medial-sided findings revealed complete tears of the AMCL and PMCL in the significant majority of patients (69%, 81% respectively), with no low-grade partial tears or intact evaluations. Laterally, the LUCL most frequently showed complete disruption but was occasionally found to be intact, while the RCL was completely torn in only 25% of studies. Complete tears occurred with significant more frequency on the medial side (AMCL/PMCL) as compared to the lateral side (LUCL/RCL).

Conclusion: Complete ligamentous tears are more common on the medial side (AMCL, PMCL) than the lateral side
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(LUCL, RCL) of the elbow following dislocation. While no MRI studies showed an intact AMCL or PMCL, both the LUCL and the RCL were occasionally found to be intact. These data support that some acute elbow dislocations occur with an initial medial-sided disruption, perhaps resulting from a hyperphysiologic valgus moment, and that complete ligamentous disruption of the lateral side is not always present. Information on elbow ligamentous injuries is important for directing post-dislocation rehabilitation, as various protocols can selectively protect or stress different ligaments.

Notes:

Outcomes of Elbow Dislocations in the National Football League (NFL)

Edward Chang, MD
Michael G. Ciccotti, MD
Christopher C. Dodson, MD
Matthew L. Ramsey, MD
Peter F. DeLuca, MD

Introduction: The elbow is the second most commonly dislocated joint in the body behind the shoulder in the adult population. Although much literature exists regarding the treatment and management of elbow dislocations in the general population, there is little information regarding management of the athletic population. Furthermore, there is no literature regarding the post-injury treatment and the factors that influence return to play in the professional, contact athlete. The purpose of this study is to follow the clinical course of elbow dislocations in the professional athlete and determine what factors influence the patient’s outcome and ability to return to play.

Methods: From 2000-2011, patients with elbow dislocations were identified from the NFL Injury Database. Roster position, player activity and clinical course will be reviewed. The average days lost as well as use of external bracing will also be recorded.

Results: From 2000-2011, there were 35,324 injuries. 62 (0.17%) patients with elbow dislocations were identified. 52/62 (83.8%) occurred during the game while 10/62 (16.1%) occurred during practice and the offseason. 40/62 (64.5%) dislocations were found in defensive players, 12/62 (19.4%) were in offensive players, and 10/62 (16.1%) were in special teams. 4/62 patients (6.5%) required surgery. Average days lost in patients treated conservatively were 32.7 days (Median 25.0 days, Min, Max 0.0-118) while patients treated with surgery were 54.8 days (Median 46.5 days, Min-Max 3.0-123.0). 2 patients (3.2%) wore bracing or wrapping upon return to play.

Conclusion: Elbow dislocations comprise less than 1% of all injuries in the National Football League. The majority of injuries occurred in defensive players. Most dislocations were treated conservatively. Average days lost was greater upon patients receiving surgery. Upon return, protective bracing or wrapping was not generally employed.

Notes:

Short-Term Effects of Steroid Injection Treatment of Trigger Finger

Karthik Jonna, MD
*Jenifer Hashem, MD

Introduction: While there is ample information available on the long-term outcomes of corticosteroid injection in the treatment of trigger finger, there is a dearth of information available on the immediate impact of this treatment. This study examines the short-term timeframe of flexor tenosynovitis (trigger finger) symptom relief in adults following corticosteroid injection.

Methods: Adult patients presenting with trigger finger were recruited from the practice of the senior author. Treatment entailed a local injection of 5mg triamcinolone (TCA, or kenalog) with 1.0ml of 1% lidocaine. Patients were then given a chart and a survey to track the improvement of their symptoms over the two weeks immediately following treatment. Short-term responses to treatment and symptom severity were assessed daily over the survey period.

Results: Our study examined 48 patients. The mean age of the group was 60 years. The majority of patients were female (65%). 88% of patients were right-hand dominant and 65% of patients reported triggering in their dominant hand. The median duration of symptoms prior to treatment was 3
months. 10% of patients were diabetic. Median recovery time was 4 days for non-diabetics versus 21 days for diabetics.

**Discussion and Conclusions:** Our study provides important information that surgeons can impart to patients about recovery timeframes following trigger finger injection. There was a trend toward earlier recovery from a steroid injection for non-diabetics than for diabetics; however, this result did not reach significance due to the small number of diabetic patients. With this information, patients can be advised to undergo surgery in a timely fashion if injection fails to provide relief. Patient outcomes may also be improved with better-informed expectations for the timing and extent of their recovery.

**Notes:**
**Percent Body Fat Is More Discriminatory than BMI for Perioperative Outcomes After Total Joint Arthroplasty**

Ramon A. Ruberte Thiele, MS  
Cameron K. Ledford, MD  
Robert J. Butler  
J. Stephen Appleton Jr.  
Samuel S. Wellman, MD  
David E. Attarian, MD  
Robin M. Queen, PhD  
Michael P. Bolognesi, MD

**Introduction:** Obesity is classically defined by body mass index (BMI); however, BMI fails to distinguish fat mass from lean mass which can be distinguished by measuring percent body fat (PBF) using clinically efficacious methods. Since PBF provides a more patient-specific measure, it may be more helpful than BMI in identifying perioperative total joint arthroplasty (TJA) risk and outcomes but this has yet to be examined.

**Methods:** Perioperative outcomes were collected on 155 adult patients undergoing primary total knee (86) or total hip (69) arthroplasty. Height and weight were measured to calculate BMI while PBF was determined by bioelectrical impedance. Patients with BMI ≥30 kg/m^2^ and PBF ≥25% in men or ≥31% in women were classified as obese. Statistical analysis was performed using independent t-tests and ANOVA for continuous measures while Chi-Square analyses were used for dichotomous variables.

**Results:** 136 (88%) patients were obese by PBF while 95 (61%) were obese by BMI. There were no significant differences for PBF and BMI in operative time, estimated blood loss, or adverse hospital events. Patients receiving postoperative blood transfusion had a higher PBF (44.5±11.4 vs. 37.6±9.8). Similarly, patients with 3-4 day length of stay (LOS) had a higher PBF (41.3±9.8) than patients who had a 2-day LOS (33.7±7.1). Finally, patients who were discharged to an extended care facility exhibited a greater PBF (42.2±10.5) compared to patients discharged home (36.8±9.5). Interestingly, no significant differences for blood transfusion, LOS, or discharge disposition were observed for BMI.

**Discussion and Conclusion:** Higher PBF was more discriminatory in perioperative blood transfusion, increased hospital LOS, and discharge to an extended care facility compared to BMI. PBF may prove to be a more effective measure in screening for perioperative risks associated with TJA. We continue to use this screening technique to improve our ability to identify TJA patients at risk.

**Notes:**

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**Evaluating Complications of the Direct Anterior and Direct Lateral Approaches in Total Hip Replacement**

Lesley Walinchus, BS  
*Javad Parvizi, MD, FRCS  
Mitchell Maltenfort, PhD  
Camilo Restrepo, MD

**Introduction:** In recent years, the intermuscular direct anterior approach (DA) has become increasingly more frequent in total hip arthroplasty (THA) and is sometimes favored over the direct lateral approach (DL). The goal of this study...
is to evaluate the incidence of complications and reoperations in relation to both approaches.

Methods: Using our institutional database, we retrospectively evaluated 582 patients (48.5% female, age 60.79 [16.88 to 95.29]) who underwent THA from three experienced surgeons in 2010. There were 286 (49.1%) patients who received the DA approach and 296 (50.9%) patients who received DL. Each surgeon had well surpassed the learning curve for either DA or DL. Four analyses were performed to investigate any complication, reported anemia, surgical repair, and revision.

Results: A higher incidence of complications was shown to be significant in patients who received the DL approach (OR: 2.98). Other additional variables shown to have higher incidence of any general complication were bilateral patients, patients with low preoperative hematocrit levels, and higher Charleston Comorbidity Index. The DL approach also proved to be a strong predictor of reported anemia (OR: 3.60). Approach type was not found to be associated with incidence of revision, yet DL showed borderline association with incidence of surgical repair.

Discussion and Conclusion: In this analysis, the DL approach was associated with both higher incidence of any general complication as well as reported anemia. In the future, a larger cohort could further support this conclusion and provide greater support for surgeons who favor the direct anterior approach.

Notes:

Heterotopic Ossification After Primary Total Hip Arthroplasty with Direct Anterior Approach: Influence of Technique and Chemoprophylaxis

Rupesh Tarwala, MD
Jose A. Rodriguez, MD
Parthiv A. Rathod, MD
Jonathan Robinson, MD

Introduction: The incidence of heterotrophic ossification after primary total hip arthroplasty (THA) has been reported to be between 8 to 90%. There exists limited data on the incidence of heterotrophic ossification after direct anterior approach (DAA) THA. The purpose of this study was to assess the incidence of heterotrophic ossification after THA via the direct anterior approach and the influence of surgical technique and chemoprophylaxis.

Method: A consecutive series of four hundred two primary uncemented direct anterior approach total hip arthroplasties in 378 patients was reviewed for incidence of heterotrophic ossification. In the first 200 total hip arthroplasties an anterior capsulectomy (Group 1) was done for exposure while in the subsequent 202 total hip arthroplasties a capsulotomy (Group 2) followed by complete release of supero-lateral flap of from its attachment to the gluteus minimus muscle and trochanter was performed. Group 1 received warfarin for thromboprophylaxis; while aspirin (thromboprophylaxis prophylaxis) and celecoxib (pain) was used in group 2. Heterotrophic ossification was classified according to Brooker’s classification on plain radiographs.

Results: Heterotrophic ossification was significantly less in group 2 (4/202, 1.98%) as compared to group 1 (29/200, 14.5%). No severe heterotrophic ossification was found in group 2.

Conclusion: Release of the superior-lateral capsular flap from the minimus exposes the trochanter for ease of retractor placement. When combined with aspirin and celecoxib chemoprophylaxis, this technique may diminish heterotrophic ossification.

Notes:

Orthopaedic Device Regulation: Should New Implants for Total Joint Replacement Undergo Further Scrutiny?

Kshitijkumar Agrawal, MD
Hany Bedair, MD

Introduction: Many recent studies and implant recalls have called into question device approval process by the FDA. Currently, Implants either undergo a 510K approval where a new device has to be shown as substantially equivalent to predicate device and pre-market approval (PMA) process.
which require safety and efficacy data. In this study, we tried to determine if either of these FDA approval processes can predict performance of the implant.

**Methods:** We reviewed the 2011 Australian Registry for the five top and bottom performing Hip and Knee prosthesis. We then queried the FDA’s databases for these implants to determine their approval process. For devices approved by the 510k process, we also investigated the approval lineage of predicate device(s) similarly. We then compared the approval processes between the top and bottom performing devices.

**Results:** Of twenty devices reviewed, only one implant underwent the more stringent PMA approval. The implants approved through 510k process were found to have demonstrated substantial equivalence to a chain of at least 3 predicate devices before being associated with a device that underwent PMA approval. All three recently recalled implants were approved through 510K premarket approval. Both well performing, poorly performing, and recalled implants served as predicates for new implants.

**Discussion and Conclusion:** The 510k approval process may not be able to identify the small differences in implant designs which affect their performance however, even the top performing implants are approved through the similar process of substantial equivalence. A balance should be achieved between the PMA and 510k processes in order to continue to promote the tradition of orthopedic device innovation while maintaining the highest level of safety and efficacy standards for our patients. Without significant post-approval surveillance of implants, poor performing implants may not be identified and catastrophic failures, as those seen recently, will continue.

**Notes:**

Morteza Meftah, MD
Stephen J. Incavo, MD

**Predicting Factor for High Metal Ions and Failures of a Modular Neck Stem**

**Background:** A modular neck stem was recently recalled due to the increase in corrosion at the neck-stem junction. The aim of this study was to investigate the clinical and radiographic results of this stem, and analyze the correlation between with the metal ion levels and failures.

**Methods:** Between June 2009 and July 2012, 107 stems with modular neck against highly cross-linked polyethylene were implanted in 92 patients by a single surgeon via the modified anterolateral approach. Correlation between clinical results, serum Chromium (Cr) and Cobalt (Cb) levels, and failures were analyzed.

**Results:** The mean follow-up was 2 years. The mean Cr and Cb levels were 2 ± 1.2 µg/L (0.1 – 4.3) and 5.1 ± 5.7 µg/L (0.2 – 25.2), respectively. 46% of patients had elevated metal ion levels. There were 13 revisions (12%) due to high Cr/Cb levels and painful hips (so far); with a mean Cr and Cb levels of 2.4 µg/L and 13.8 µg/L. Higher body mass index (BMI) and younger age were significant predictors of high cobalt levels (p<0.001). Presence of adverse local tissue reaction and pseudotumor was strongly correlated with failures.

**Discussion and Conclusions:** High failure rate of the modular neck stem due to metal corrosion is alarming. The majority of the failures occurred during the second year after the implantation. We suspect more symptomatic patients in this cohort will be scheduled for revision in near future. The use of modular neck implants, especially in obese or young patients are not recommended.

*The FDA has not cleared this drug and/or medical device for the use described in the presentation. (Refer to page 54).*

**Notes:**

Steven M. Kurtz, PhD
Sevi Kocagöz, BS
Josa A. Hanzlik, MS
Jeremy L. Gilbert, PhD
Daniel W. MacDonald, MS
Javad Parvizi, MD, FRCS
Clare Rimnac, PhD

**Do Ceramic Femoral Heads Reduce Taper Fretting Corrosion in Hip Arthroplasty?**

**Background:** Recent implant design trends have raised renewed concern regarding metal wear debris release from
modular connections. Previous studies regarding modular head-neck taper corrosion were largely based on cobalt chrome (CoCr) alloy femoral heads. Comparatively little is known about head-neck taper corrosion with ceramic femoral heads.

**Questions/purpose:** This study addressed the following research questions: 1) Could ceramic heads mitigate electrochemical processes of taper corrosion compared to CoCr heads? 2) Which factors influence stem taper corrosion with ceramic heads? 3) How does the mechanism of stem corrosion at the interface with a ceramic femoral head differ from stem corrosion with a CoCr head?

**Methods:** 100 femoral head-stem pairs were analyzed for evidence of fretting and corrosion. A matched cohort design was employed in which 50 ceramic head-stem pairs were matched with 50 CoCr head-stem pairs based on implantation time, lateral offset, stem design and flexural rigidity.

**Results:** The fretting and corrosion scores were significantly lower for the stems in the ceramic head cohort when compared with the CoCr head cohort. Stem alloy and stem flexural rigidity were predictors of stem fretting and corrosion damage in the ceramic head cohort, however these stem factors were not predictors for the metal head cohort. The basic mechanism of mechanically assisted crevice corrosion was the same in the two cohorts, with the exception being that, in the case of a ceramic femoral head, only one of the two surfaces (i.e., the male metal taper) engaged in the oxide abrasion and repassivation process.

**Conclusions:** The results suggest that by using a ceramic femoral head, CoCr fretting and corrosion from the modular head-neck taper may be mitigated, but not completely eliminated. The findings of this study support further study of the role of ceramic heads in potentially reducing femoral taper corrosion.

**Notes:**
patient risk stratification may be a reasonable approach to combating the costs associated with the process.

Notes:

Operative Time Directly Correlates with Blood Loss and Need for Transfusion

David Ross, BS
Ömer F. Erkoçak, MD
Mohammed R. Rasouli, MD
Javad Parvizi, MD, FRCS

Introduction: Allogeneic blood transfusion in patients undergoing total joint arthroplasty (TJA) has been shown to negatively affect patient outcomes. The purpose of this study was to examine if there is a correlation between operative time and the need for allogeneic blood transfusions during TJA.

Methods: We performed a retrospective review of 866 patients who underwent primary TJA during a one-year period at our institution. Logistic regression was performed to identify the association between operative time and need for allogeneic blood transfusion, controlling for other patient and surgical factors. Multiple linear regression analysis was also performed, looking at how the same factors affected calculated blood loss (CBL).

Results: Of the 866 cases, 13% (115) were simultaneous bilateral. 52% (449) of patients received preoperative autologous blood donation. The average operative time for unilateral and bilateral patients was 74.1 ± (33.9) and 132.6 ± (36.0) minutes, respectively. Average CBL for unilateral patients was 2120mL ± (1208) and 4051mL ± (1311) for bilateral cases. The average number of allogeneic transfusions was also higher within the bilateral group (0.49 vs. 1.15 units). Multivariate analysis indicated that duration of surgery (odds ratio (OR): 1.35 per 15 minutes) and bilateral TJA (OR: 2.97) increases the risk of allogeneic blood transfusion, while patients having total knee arthroplasty are less likely to receive allogeneic blood transfusion (OR: 0.50).

CBL also increased significantly with surgical duration (211.5mL per 15 minutes).

Discussion and Conclusion: A subgroup analysis confirmed that there was a correlation between operative time and need for allogeneic transfusion following unilateral TJA (OR: 1.31). Expeditious surgery can minimize blood loss and subsequent need for blood transfusion with all its associated adverse consequences.

Notes:

Anatomic Physeal Distance About the Knee in Skeletally Immature Patients

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Introduction: Mid-substance tears of the anterior cruciate ligament (ACL) in children or adolescents can no longer be considered a rare injury. The purpose of this study was to provide measurements to aide in safe placement of femoral & tibial tunnels during ACL reconstruction by providing average distances to the physis about the knee in the skeletally immature patient.

Methods: Magnetic resonance images (MRIs) of one hundred and ninety nine children (age range, six to seventeen years) were evaluated. Three measurements were made on the lateral femoral condyle from the physis to base of the cartilage cap to determine an average height. Three measurements were made in the tibia, one for height, and two for proposed tibial tunnels for placement of ACL grafts. Tibial height was measured from the physis to the subchon-
dral bone at the posterior edge of the ACL. The potential epiphyseal tibial tunnel measurement was made also from the physis to subchondral bone but at a 55-degree angle from the horizontal physis to the posterior aspect of the ACL. Transphyseal tibial tunnel measurement was made along same 55-degree angle from the subchondral bone to inner anterior cortex.

Results: The mean average of lateral femoral epiphyseal height increased sequentially with age and reached a plateau of 21.5mm at an age of sixteen years. The mean tibial epiphyseal height also increased to reach its peak of 13.3mm at thirteen years. The mean transphyseal tibial tunnel measurement was highest at sixteen years of age (35.5mm).

Discussion and Conclusion: Drilling transepiphyseal tunnels in the femur & the tibia appear to allow safe placement of tunnels up to 10mm & 8mm respectively in children/adolescents between the ages 10-17 years of age. These tunnel diameters may support physeal-sparing anatomic ACL reconstruction for skeletally immature patients in the future.

Notes:

It’s Always Sunny in the Operating Room — The Effects of Weather on Operative Pediatric Volume at One Institution

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Introduction: It has been anecdotally proposed that overcast weather patterns result in fewer pediatric orthopaedic injuries, however, this has never been investigated. Understanding the weather related trends of orthopedic injuries may help hospital systems delegate resources in an efficient and cost effective manner.

Methods: We retrospectively reviewed the operative schedule for all add-on orthopaedic trauma cases at one institution from June 1st to August 30th 2012. For each patient that underwent surgery, we reviewed the identified the nature and the date of the injury. Cases without a causative traumatic injury or without a known date of injury were excluded. Using climate data from the National Weather Service, the amount of cloud coverage (on a scale from 0 to 10) was recorded over the same time period. Three groups were compared: sunny (0-2), partly cloudy (3-6), or cloudy (7-10). The number of operative days, total cases, and number of cases per day were recorded for each group. ANOVA analysis was used to compare groups.

Results: There were a total of 37 sunny days, 30 party cloudy days, and 19 cloudy days. Of the 119 operative injuries included in the analysis, the vast majority occurred on sunny days (n = 70, 1.9 injuries/day), followed by party cloudy days (n = 38, 1.4 injuries/day), with the least number of cases occurring on cloudy days (n = 11, 0.4 injuries/day). The number of injuries per day was significantly higher on sunny days compared to cloudy days (p < 0.001).

Conclusion: Sunny days with minimal cloud coverage resulted in four-fold increase in operative trauma cases compared with cloudy days.

Notes:

The Simplified Skeletal Maturity Method and Its Correlation with Curve Progression in Idiopathic Scoliosis

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Introduction: The simplified skeletal maturity score (SSMS) has been utilized to predict curve progression in idiopathic scoliosis (IS). Using a large cohort, this study aimed to assess the correlation of the SSMS to curve progression.

Methods: A retrospective review of 1100 patients (girls aged 8-14 years and boys aged 10-16 years) with (IS) evaluated between 2005 and 2011 was performed. Data collected
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at initial and final follow-up: age, height, weight, family history, gender, menarchal status (girls), curve magnitude, modified Lenke curve type (1-6), Risser stage, duration of follow-up and initial SMSS. The end-point was defined by skeletal maturity or curve progression to =>50°. Patients with less than 1 year follow-up, non-idiopathic curves or previous spine surgery were excluded. Chi square test and logistic regression models were used.

**Results:** There were 135 patients, 113 (83.7%) girls and 22 (16.3%) boys. Mean age of girls was 12.2 years (8.4-14) and of boys was 14.1 years (12.6-15.6). Distribution of patients within SMSS 1 through 7 was: 5, 25, 36, 34, 6, 26 and 3 respectively and modified Lenke curve types 1-6 was: 20, 8, 55, 4, 32 and 16 respectively. All patients with initial Cobb angles (35°-45°) in the SMSS 1, 2 and 3 progressed to =>50°. On the other hand, no patients with initial 10°-30° curves in the Sanders stages 5-7 progressed to =>50°. The observed progression in patients with an initial curve of 30° was: SMSS 2=86%, SMSS 3=60% and SMSS 4=20%. The percentage progression to >50° for all initial curves of 15°-20° was less than 50%. No patient with an initial curve of 10° progressed to surgery in this cohort.

**Conclusion:** This substantially larger cohort shows a strong predictive correlation between SSMS and initial Cobb angle for probability of curve progression in idiopathic scoliosis to surgery.

**Notes:**

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**Pediatric ATV Injuries: Incidence and Cost in the State of Pennsylvania**

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Raveesh D. Richard, MD  
Thomas R. Bowen, MD  
Wade R. Smith, MD, FACS

**Background:** ATV (All-Terrain Vehicle) injuries are a source of significant morbidity and mortality across all age groups. Pennsylvania is second in ATV related injury and deaths with children < 16 accounting for 28% of these injuries in 2007. Despite recommendations from the American Academy of Pediatrics that children under 16 not drive ATV’s, children < 12 accounted for 51% of ATV related hospital admissions. We hypothesized that these injuries carry a substantial cost.

**Aims:** Evaluate the severity and incidence of ATV related pediatric injuries in the state of Pennsylvania and correlate these with a cost model generated from admission data to Geisinger Medical Center.

**Methods:** Population-based retrospective cohort design. We reviewed the costs of care of children injured during a four-wheeled ATV accident January 1, 2007, to December 31, 2009 admitted to our institution.

**Results:** In this cohort of 78 pediatric patients (age 2-16) involved in ATV accidents, the cost of care varied greatly, from a few hundred dollars to over $300,000. In general, older patients had higher costs on average and those patients who wore helmets, were drivers, had an ejection or a crash with a stationary object (as opposed to other types of crash) had lower costs on average. The only statistically significant finding was that crashes with stationary objects resulted in lower costs on average than other types of crashes (cost ratio = 0.40, 95% confidence interval = 0.20 to 0.79). Patients involved in rollover accidents were much more likely to require a hospital stay of 1 day or longer as compared to patients in all other types of crashes (odds ratio 3.58, 95% confidence interval = 1.39 to 9.25, p=0.01). In addition, patients who wore helmets were marginally less likely to require an overnight hospital admission than those who did not (odds ratio 0.34, p=0.07).

**Conclusions:** Interventions to increase helmet use among ATV riders and measures to improve ATV stability seem warranted.

**Notes:**
Are Early Post-Operative Radiographs After Adolescent Idiopathic Scoliosis Surgery Clinically Useful?

Michael Pensak, MD
Mark Lee
Jennifer Bayron
Jeffrey Thomson

Introduction: It is unclear whether the high frequency, routine spine radiographs in the first 6 months after posterior spinal fusion (PSF) for adolescent idiopathic scoliosis (AIS) contribute meaningfully to clinical management, while exposing the patient to increased ionizing radiation.

Methods: A single institution, retrospective chart and radiograph review of patients undergoing PSF for AIS over a 5-year period was performed. Radiographic abnormalities on standing scoliosis films were classified as hardware-related findings (malpositioning and/or hardware failure) and non-hardware related (thoracic and abdominal abnormalities). Charts and additional radiographic studies were reviewed to identify abnormalities missed on standing scoliosis radiographs and to determine if the plain radiographic finding altered clinical management.

Results: 129 patients were included in the study: 91 females and 38 males with an average age at surgery of 14.4 yrs. 761 total spine radiographs were taken in the first 6 months after surgery (average 5.9 films per patient). 749 (98.4%) films were normal and 12 (8 patients) were abnormal (1.6%). Of the 121 patients with normal radiographs, one patient was later found to have a screw malposition requiring return to the OR and another patient had a spontaneous duodenal perforation identified on an abdominal series requiring repair. Of the 8 patients with abnormal films, one patient had a partial screw pullout that was treated with bracing and another patient had a pleural effusion that required drainage. The remaining 6 patients had mild pulmonary findings that required no change in clinical management.

Discussion and Conclusion: Routine use of serial standing radiographs after scoliosis surgery has a low sensitivity in detecting clinically relevant hardware-related or non-hardware related complications in the first 6 months after surgery for AIS. Consideration should be given to modifying the typical algorithm of high frequency serial plain radiographs in the early post-operative period after AIS surgery.

Notes:

Intraoperative Monitoring of Epiphyseal Perfusion in Slipped Capital Femoral Epiphysis

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Introduction: This study evaluates an innovative method of intra-operatively monitoring femoral head (epiphyseal) perfusion in patients with slipped capital femoral epiphysis and compares those results with the subsequent development of avascular necrosis.

Methods: Standard percutaneous SCFE screw fixation technique utilizing a radiolucent table and supine positioning is performed. A fully threaded cannulated stainless steel 7.0-mm screw is inserted into the epiphysis. The guide wire is removed and a sterile ICP probe is placed through the screw such that the tip is in the epiphyseal bone past the tip of the screw. Intra-operative epiphyseal pressure and waveform are recorded. Based on clinical and intra-operative data, a hip capsulotomy is performed. The ICP probe is removed and the cannulated screw is advanced to its final seating depth. Radiographs are monitored for the development of AVN.

Results: No complications from the use of the ICP monitor have occurred. Waveforms recorded intra-operatively are similar to arterial tracings. Our series includes unstable SCFE patients with poor flow pre-capsulotomy and increased perfusion post-capsulotomy. All patients left the operating room with measurable femoral head flow; no patient has subsequently developed AVN of the femoral head.

Discussion and Conclusion: Femoral head perfusion in patients with SCFE can be measured intra-operatively using this technique. Demonstrating perfusion before leav-
Transphyseal Tunnel Reconstruction of the ACL in Patients with Open Physes — Not a Cause for Growth Arres

Marielle A. Connor, MD
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Introduction: Anterior cruciate ligament ruptures in skeletally immature patients are an increasingly common problem. Numerous methods have been described to restore stability to the skeletally immature patient after an ACL rupture including primary repairs, extraarticular tenodeses, all-epiphyseal reconstructions, and transphyseal reconstructions. However, the optimal surgical treatment in the immature knee with open physes remains controversial. This study was designed to evaluate the safety and efficacy of transphyseal ACL reconstruction in patients with open physes. Our hypothesis was that transphyseal ACL reconstructions do not cause significant growth disturbances, including limb length discrepancies or angular deformities.

Methods: This study is a retrospective review of skeletally immature patients who underwent transphyseal ACL reconstructions at a single institution from January, 2000 to December, 2011. Pre- and post-operative imaging and medical records were reviewed to determine the presence or absence of premature physeal closure, clinical leg length discrepancies, and angular deformities.

Results: Seventy-eight patients underwent reconstruction by four different surgeons. After excluding patients with closed physes at presentation (12), with short follow up (10), and with inadequate radiographs at final follow-up (28), there were 28 patients available for review. The average age at the time of reconstruction was 12 years 6 months (range 8 years 9 months to 14 years 7 months). The average femoral and tibial tunnels were 7mm and 8mm in diameter. Average follow up was 28.6 months. No growth disturbances were noted. No patient had a leg length discrepancy or angular deformity at final follow up.

Discussion and Conclusion: Placing soft tissue grafts across the femoral and tibial physes to reconstruct the ACL did not cause growth disturbances in this patient population. Transphyseal ACL reconstruction should be considered a viable treatment option for ACL ruptures in skeletally immature patients.

Notes:
**Results:** An increase in the lateral coverage of the acetabular roof was observed in 13 of 14 patients. Immediately after the Salter osteotomy, the acetabular roofs were equal in length. However, in 13 patients, the rate of growth on the operated side was consistently higher in comparison to the non-operated side, averaging 0.57 cm/year (range: 0.13 cm/year to 1.6 cm/year), compared to an average of 0.32 cm/year for the non-operated side. The actual difference between acetabular roof measurements ranged from 0.1 cm to 1.7 cm and averaged 0.59 cm. At final follow-up, the operated side was an average of 1.2 times larger than the contralateral side.

**Discussion and Conclusion:** This study suggests that the Salter osteotomy not only redirects the acetabulum but also stimulates an increase in acetabular growth, producing additional femoral head coverage.

**Notes:**

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**Introduction:** Periprosthetic joint infection (PJI) remains a feared complication. The major reason for failure of treatment relates to formation implant-adherent bacteria, or so called biofilm, that allows infecting organism to evade the immune surveillance of the host and protection from systemic antibiotics. Various mechanical methods, such as pulse lavage, have been used to disrupt this glycocalyx matrix. However, this “blast” approach carries the risk of pushing bacteria deeper into the surgical deep and possible soft tissue contamination. Herein, we explore the novel use of a hydro-debridement system for the targeted biofilm dissociation on metal prosthesis.

**Methods:** Staphylococcus aureus (SA) was seeded on Titanium alloy (Ti6Al4V) disks and allowed to form mature biofilms for 24 hours. Samples were then either: left untreated as controls; Pulse-lavaged, hydro-debrided, incubated in 10µl/ml vancomycin for 3 hrs. All samples were then immunostained and visualized using confocal microscopy, and scanning electron microscopy (SEM). Surface topography was assessed and morphometric analysis was used to quantify bacterial burden on surfaces and expressed as percentage decrease from controls.

**Results:** Surfaces were successfully colonized with SA that produced thick biofilm as seen by SEM, which was grossly unaffected after treatment with antibiotics. Following staining and confocal microscopy, morphometric analysis showed that vancomycin incubation, hydro-debridement and pulse lavage resulted in 75.5%, 97.5% and 99.8% decrease in bacterial colonization of the metal surfaces, respectively. Qualitatively, hydro-debridement seemed to incompletely disrupt biofilm within surface crevices while also mildly altering sample topography of the metal by creating micro-scratches.

**Discussion:** New tools are needed to disrupt biofilms and divest bacteria off implant surfaces in a controlled and targeted manner. We show that the use of a hydro-dissecting system for this novel application is feasible and discuss basic modifications in design that could significantly improve its efficacy in biofilm dispersal while offering distinct advantages over currently available systems.

*The FDA has not cleared this drug and/or medical device for the use described in the presentation. (Refer to page 54).*

**Notes:**
Bone Marrow Derived Stem Cells as a Treatment for Osteoarthritis of the Knee

Daniel T. Eglinton, MD

**Introduction:** A prospective, cohort randomized longitudinal study to develop protocols, criteria, and outcomes of measurements to evaluate the effectiveness of this treatment in osteoarthritis of the knee. Current treatment regimens for osteoarthritis in the active older population have followed the treatment regimen of Feely et al presented in AAOS v.18, page 406-415. These have resulted in variable outcomes, and the number of patients and reconstructive procedures have exploded. Can stem cells provide an adjunct to current treatment regimens to delay those reconstructive procedures and their associated costs? To this end the study was developed based on an exhaustive literature review of the biology and interventions of stem cells as of 2013.

**Methods:** 60cc’s of bone marrow aspirate was obtained from the anterior iliac crest. The aspirate was centrifuged and separated into stem cell rich (5-7,000 cfu’s) and stem cell poor with platelet poor plasma from which a plasma gel was made. After standard arthroscopic debridement and chondroplasty with micro-fracture the stem rich (6cc) with 6cc’s of the poor (activated with thrombulin and calcium) was injected into the knee.

**Results:** 1. Study ran on 06/12/2009 to 05/21/2010. 2. 96 patients (75 female and 21 male) 3. Range Average 61 years old 4. 30 Right, 28 Left, Bilateral 38 Knees 5. ROM, Pre-op Average 10 degrees – 100 degrees, post-op Average 5 degrees – 115 degrees. 6. Tegner Scores (84-90 Good), Womac Pain Pre-op and Post-op 3, Weight change? 10% lost 10-75lbs 85% the same, 5% gained. 7. Grade Arthritis, grade 3 (32%) Grade 3-4 (78% of which 20% primarily Grade 4. 8. 25% Uni-compartmental, 25% Bi-compartmental, 50% Tri-compartmental. 9. Swelling 19-22 days dramatic decrease. 10. Would recommend at 6mc 100% one year 95% (6 totals/one at one year 16% failure major complaint, increased pain over function which remained good except for stairs.

**Discussion and Conclusion:** Stem cell therapy use in Grade 3 and Grade 3-4 osteoarthritis predominantly appears to show promise as an adjunctive treatment for osteoarthritis of the knee. In the 6 patients in which a total knee replacement was performed at one year all showed 3-5 mm of hyaline (hyaline like) cartilage with new bone formation. A future level 2-3 study is planned based on newer imaging techniques and cytokine measurements to assess the effectiveness of this treatment regimen.

*The FDA has not cleared this drug and/or medical device for the use described in the presentation. (Refer to page 54).

Notes:
and 2.5-fold higher at day 7 (p<0.001). Additionally, day 4 femora showed significant increases in cartilage generation (p<0.001) and callus area (p<0.001). Mechanical testing at 6 weeks revealed a two-fold greater maximum torque to failure (p<0.001) and stiffness (p=0.006) versus control groups. No significant differences were found in levels of PDGF-AB, TGF-β1, VEGF, or IGF-1 in the callus extracts from the PEMF-treated diabetic rats.

**Discussion and Conclusion:** PEMF treatment increases callus cell proliferation and early chondrogenesis in diabetic rats, resulting in improved mechanical parameters of the fracture callus 6 weeks after fracture. These effects on early callus formation led to a 2-fold increase in peak torque to failure and stiffness.

**Notes:**

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**Photo/Chemical Bonding of Osteochondral Transplants Through Novel Chitosan Hydrogel Cross-Linkers**

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Stephanie Grenier, PhD  
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**Introduction:** Repair of the graft-host interface in autologous osteochondral transplants occurs with the formation of fibrocartilage. Moreover, the discontinuity at the transplant-host interface allows synovial fluid influx, causing cyst formation. This study explores the use of chondroitinase-ABC (Ch-ABC) and three different polymer/cross-linker combinations: chitosan and genipin (Chi-GP); chitosan and rose bengal (Chi-RB); and chitosan, rose bengal and genipin (Chi-RB-GP) to improve the cartilage-to-cartilage interface.

**Methods:** Bovine cartilage plugs were sliced into 2 mm thick discs and a 5 mm defect was created using a biopsy punch, establishing an annulus and core. Ch-ABC was brushed onto the surface of the annulus and core. A chitosan and a cross-linker mixture was then introduced. The specimens treated with Chi-GP were incubated for 15 min at room temperature to allow diffusion of the mixture within the tissue and efficient initiation of the gelation process. Chi-RB and Chi-RB-GP samples were first incubated for 15 min, and then exposed to visible light for another 15 min period. For the control group, the cores were inserted into their respective annuli without any treatment and incubated in PBS. Push-out tests were performed to determine the adhesion strength at the interface. The fluid permeability of the specimens was also assessed.

**Results:** When compared to the control, all of the treated explants produced significantly higher adhesion strengths. The Chi-RB-GP treatment resulted in significantly superior adhesion strength in comparison to the other two treatments. Indeed, there was no statistically significant differences in fluid velocity found between the intact and treated specimens in all groups.

**Discussion:** Chitosan used in combination with cross-linking reagents provided strong interfacial mechanical properties, while the Chi-GP duo provided superior restoration of the permeability at the area of cartilage divergence. Future studies will be conducted to determine chondrocyte viability in treated and untreated explants in vitro.

**Notes:**

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**The Effects of Atorvastatin Calcium on Lumbar Vertebrae in Corticosteroid Treated Rabbits**

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**Introduction:** Statins may have a protective effect on corticosteroid-induced osteoporosis, a clinically important question. We have previously shown that this protection does not extend to the appendicular skeleton. We extend this work now to the axial skeleton, since the two bone compartments may behave differently.
Methods: 20 adult NZW Rabbits were divided into control, corticosteroid alone (2 mg/kg/week), and two statin groups (receiving both weekly corticosteroid and daily oral atorvastatin calcium at 2 and 20 mg, respectively). L6 vertebrae were tested under a compressive load to measure the yield strength. L7 vertebrae were evaluated by histomorphometry of sections.

Results: Mechanical testing of L6 vertebrae showed that irrespective of atorvastatin dosage, the vertebrae from steroid treated animals were at least 50% weaker than controls (statistically significant). Histomorphometry revealed that the corticosteroid only group had global osteopenia, with decreased trabecular volume and number, and increased trabecular separation. In contrast, the statin group had increased metaphyseal trabecular bone, but frank trabecular bone loss at mid-vertebra and increased woven bone, a mechanically weaker bone.

Discussion and Conclusions: The preliminary data shows that the yield strength of corticosteroid plus statin treated rabbit vertebra were at least 50 % lower than the control rabbit group. This is in contrast to our previous study where the long bones lost approximately 27% of its mechanical strength when compared to controls. Spine may be more affected by corticosteroids or the combination than the long bones. Histomorphometry also confirmed the mechanical testing results by showing frank loss in the mid vertebra and formation of weak woven bone. Other statins such as simvastatin and rosuvastatin may have different effects on bone and may be better at preventing weakening from corticosteroid induced osteoporosis. This is another avenue of further investigation.

*The FDA has not cleared this drug and/or medical device for the use described in the presentation. (Refer to page 54).

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successful, may represent a viable future treatment for humans.

Notes:

Outcomes of Single-Level Cervical Disc Arthroplasty Versus Anterior Discectomy and Fusion: A Single Center, Retrospective Review

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Daniel G. Kang, MD
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Michael K. Rosner, MD

Introduction: Several studies have established the safety and efficacy of cervical disc arthroplasty (CDA) as compared to anterior discectomy and fusion (ACDF). There are few single center comparative trials, and current studies do not contain large numbers of patients. We set out to perform a single center, review in comparison of CDA to ACDF.

Methods: We performed a retrospective cohort comparison review at a single, military institution to capture all patients who underwent single-level CDA or single-level ACDF. Radiographs and patient charts were reviewed by independent researchers to determine multiple outcome variables. Data were analyzed descriptively and through the use of student t-tests where applicable.

Results: There were 198 patients included in the study. The CDA group contained 110 patients and the ACDF group had 88 patients. Average follow up time was 9.7 (±8.8) months. The CDA and ACDF groups demonstrated 90.9% and 86.4% rates of symptom relief, respectively. 93.6% of patients who underwent CDA were able to return to full activity, as compared to 88.6% in the ACDF group. The rates for recurrent laryngeal nerve (RLN) injury and dysphagia were 3.6% and 5.5%, respectively, in the CDA group. The ACDF group had no RLN injuries and 3.4% of patients reported dysphagia. The CDA group had a 16.4% rate of persistent posterior neck pain. The ACDF group had 11 patients (12.5%) with persistent posterior neck pain, and a rate of symptomatic pseudoarthrosis requiring reoperation of 2.3%.

Conclusion: In the largest non-sponsored study of its kind to date, our data suggest that both CDA and ACDF result in approximately 90% (93.6% CDA and 88.6% ACDF) of patients with complete symptom relief and a relatively low complication rate. Patients who underwent CDA had a higher rate of persistent posterior neck pain, and patients who underwent ACDF were at risk for symptomatic pseudoarthrosis.

Notes:

Morbidity of Neurologic Deficits in Vertebral Osteomyelitis

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Mark J. Ruoff, MD

Introduction: The purpose of the study is to evaluate the outcomes of patients with a neurologic deficit from vertebral osteomyelitis.

Methods: A retrospective review of 920 spinal osteomyelitis from 2001-2011 from one institution was performed. Inclusion criteria included appropriate initial imaging, lab results, and no treatment done prior to admission. Chi-squared statistic and single sample t-tests were used to examine the data.

Results: One-hundred and six patients meet the inclusion criteria specifically for the management of spinal osteomy-
elitis: 62 men (58%), 44 women (42%), mean age 54 yrs., mean follow-up 38 months. Forty-six (43%) patients had a neurologic deficit (ND) on presentation and 60 (57%) were neurologically intact (NI). The mean age (54 yrs.) and length of hospital admission (14 days) were identical in the two groups (ND, NI). The amount of deaths (directly attributable to the osteomyelitis) was higher in the ND (n=7) than NS groups (n=2) [OR: 5, p=0.04]. The ND group had higher Charlson comorbidity index scores [4.1 vs. 2.9, p=0.01]. The rate the osteomyelitis cleared was similar in the two groups: ND 63% (n=55) and NI 65% (n=39) [p=0.8]. Oswestry scores from initial presentation to final follow-up significantly improved in the NS (62 to 38) compared to the ND group (63 to 46). Thecal sac compression was significantly higher in the ND 39% (n=18) compared to the NI group 17% (n=10) [OR: 3.2, p=0.01]. The mean cost of hospital admission (directly related to the osteomyelitis) for ND and NI were similar [$234,819 vs. $245,613].

**Conclusion:** Patients with a neurologic deficit from osteomyelitis have significantly more morbidity and mortalities: higher Charlson comorbidity indexes, less improvement in Oswestry scores, and higher mortality rates. The rates at which the osteomyelitis cleared and the cost of the hospital admissions were equivocal.

**Notes:**

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**Pulmonary Function Testing and Risk of Perioperative Pulmonary Complications in Patients with Cervical Myelopathy and Myelomalacia**

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Julia F. Martha
Ling Li
Tal Rencus
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Brian Kwon

**Introduction:** The association between traumatic cervical spinal cord injury (SCI) and pulmonary complications is well-established. A potential similar relationship between cervical myelopathy and cervical myelomalacia has not previously been examined. The purpose of this study was to prospectively evaluate pulmonary function and the occurrence of adverse pulmonary events in a series of patients with cervical myelopathy and myelomalacia.

**Methods:** Twenty-two consecutive patients undergoing surgical decompression for cervical spondylotic myelopathy were selected based on preoperative MRI cord signal changes. Myelopathy was graded and all patients were prospectively evaluated for pulmonary function (PFT). Pulmonary-related complications were noted. MRIs were evaluated by three readers.

**Results:** Formal PFT revealed a mild but significant impairment of pulmonary function based on forced vital capacity and forced expiratory volume in 1 second. There was no association between the severity of clinical myelopathy and PFT performance. Similarly, the severity of radiologic myelomalacia was not associated with PFT measures. No association was noted between cervical myelopathy, spinal stenosis, or myelomalacia and the occurrence of adverse pulmonary events. However, patients with elevated body mass index (BMI) and high Charlson Index score experience an elevated rate of adverse pulmonary events following surgical decompression (BMI 35.8±6.0 vs. 28.5±6.2; Charlson Index score 3.0±0.8 vs. 1.0±1.4).

**Discussion and Conclusion:** This prospective study supports the concept that cervical stenosis with myelomalacia is a form of mild chronic SCI. Resultant neuromuscular weakness may include muscles of respiration leading to measurable impairment of pulmonary function. Overall, the clinical consequences of such impairment appear to be mild, and no association with perioperative pulmonary complications was observed; therefore, routine PFT screening is not recommended. However, underpowering in this series may not have detected a slight risk increase. Obesity and medical comorbidities appear to represent greater risk for adverse pulmonary events in the perioperative period following treatment for cervical myelopathy.

**Notes:**
What Drives Quality in Spine Surgery? Perceptions Among Medical Device Representatives

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S. Raymond Golish, MD, PhD
Michael L. Reed, PT, DPT, OCS, MTC
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Introduction: Patient safety is one of the highest priorities in healthcare. Although existing research has focused on drivers of quality and surgical outcomes, little has been published on perceptions of quality. Evidence that surgeons perceive teamwork within their own teams more highly than others suggests that physicians may not be the best equipped to evaluate their own performance. We believe medical device representatives provide a unique lens into the operating room (OR) because they have a medical foundation in spine procedures and are exposed to a variety of cases, institutions, and surgical teams.

Methods: 108 spine implant medical device representatives with at least one year of OR experience were given a 21 question survey during the week of the 2011 AAOS in San Diego, CA to understand how their perceptions of spine surgical outcomes differ based on institution type, case complexity, staff quality, and surgical team composition. Four distinct practice settings were identified: university, small and large private hospitals (defined as < 6 or > 6 spine implant cases/week), and ambulatory surgery center (ASC). Overall perceptions were assessed by asking respondents how likely they would be to recommend surgery to friends/family for cases of varying complexity and practice settings.

Results: Respondents included 96 males (89%) and 12 females (11%) with a mean (±SD) of 6.3 (±3.3) years OR experience. Respondents rated their impressions of surgeons as excellent (26.5%), good (53.9%), average (16.1%), fair (3.2%), or poor (0.3%). The proportion of surgeons rated as excellent or good was significantly lower in ASC’s than in other settings (p<0.01). Significantly fewer circulating nurses were rated as excellent or good in universities versus small and large hospitals (p<0.001). In small hospitals, it was significantly more likely that 75% or more of the primary team members had worked together before versus universities (p<0.001) or large hospitals (p=0.01), while there was no difference between universities and large hospitals or between small hospitals and ASC’s (p>0.05). There were significantly more cases in which >3 people were scrubbed at universities versus all other settings (p<0.01). Complication rates did not differ significantly across settings (p>0.05). Respondents were more likely to recommend a university or large private hospital for complex instrumentation cases (p<0.001), whereas they recommended large private hospitals over universities for simple instrumentation (p<0.01). For cases without instrumentation, respondents were more likely to recommend a large private hospital over a university (p=0.003).

Discussion: Overall, medical device representatives were most likely to recommend large private hospitals for simpler spine cases, and large private or university hospitals for complex cases. Large private and university hospitals were associated with higher surgeon ratings, less consistency in the primary OR team, and similar complication rates relative to other practice settings. However, nurses received lower ratings, and more cases had at least 3 people scrubbed in university hospitals relative to large private hospitals. Together, these data suggest that the quality of all members of the surgical team, including nurses and other assistants, plays an integral role in how surgical teams are perceived.

Notes:

Midterm Self-Reported Quality of Life Outcomes After Spine Surgery for Lumbar Spinal Stenosis

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Stelios Koutsoumbelis, MD
Sara Merwin, MPH
Matthew J. Goldstein, MD
Jeff Silber, MD, DC

Introduction: Lumbar spinal stenosis (LSS) is a source of significant morbidity and economic burden, largely affecting older adults, with U.S. prevalence estimated between 8-27%, resulting in over 37,000 Medicare surgeries per year. The investigators hypothesized that patients would report overall improvement in functional and pain status postoperatively. The surgeon’s database was used to identify all LSS patients who underwent surgical treatment within the past 2–10 years.
Methods: IRB approval was obtained for a patient questionnaire with a validated instrument (Oswestry Disability Index) and 9 questions devised by the surgeon. Variables include: surgery type (laminectomy with/without fusion, interspinous device), pre-surgical symptoms (back pain, leg pain, muscle weakness, numbness, claudication) and demographics (age, sex, years since surgery).

Results: Of the initial 531 meeting inclusion, 5.4% had expired, 2.1% elected to withdraw, and 5.1% could not be traced. The patient population was 54% female with a mean age of 60.9 years (SD=14.8). The mean time since surgery at follow-up was 5 years (SD=2). Laminectomy was performed in 175 patients, laminectomy with fusion in 231, and interspinous device in 101. Pre-operatively 86.7% and 77.2% of patients rated back and leg pain as 7 out of 10 or greater, respectively. Postoperatively this improved to 13.9% and 12.7% respectively. 3.6% of cohort required additional surgery during the follow-up time period; 40.5% continued to use analgesic medication (56.7% NSAIDs). The ODI score averaged 21% corresponding to mild/moderate disability.

Discussion and Conclusion: The majority of this operative cohort reported a substantial decrease in pain after surgery with disability in the mild to moderate range. Less than 4% of patients required further surgery. These preliminary findings suggest that operative treatment for LSS by this surgeon resulted in favorable outcomes. Future analyses will focus on elucidating procedures, predisposing factors yielding the best results and outcomes at various timepoints post-operatively.

Notes:

Risk and Predisposing Factors in Surgical Site Infections After Pediatric Spinal Deformity Surgery: Density Case-Control Assessment

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Sina Pourtaheri, MD
Freeman Miller, MD
Suken A. Shah, MD

Summary: Risk factors for SSIs include: increased body weight, severe spasticity, wound problems and prolonged surgical time. SSI patients had more intra-operative complications and longer ICU stays.

Introduction: The purpose of the current study was to identify risk factors for deep wound infections with pediatric spine deformities surgery.

Methods: A retrospective review of 851 spinal deformity surgeries from 2006-2010. Cases that required an operative I&D were defined as deep wound infections. Stratified systematic random sampling with a 1:3 ratio [deep wound infections: the control group (non-infected cohort)] was used. Chi-squared statistic, Fisher’s exact, and independent sample t tests were used to examine the data.

Results: 21 patients had SSI: AIS 14%, CP 67%, syndromic 14%, congenital scoliosis 5%. The control (non-infected) group consisted of 58 patients with similar characteristics. The SSI and control groups were well matched: mean age at surgery = 13.8 yrs. (SSI),13.8 yrs. (control); Male: Female = 1.2: 1 (SSI), 1: 1.3 (control); Cobb angle = 76.8 (SSI), 78.7 (control), levels fused = 18 (SSI), 16 (control). Main risk factors for SSI events were weight, level of spasticity, wound status, and length of surgery. Mean weight = 47.6 KGS. (SSI), 38.1 KGS. (control) [p=0.06]. The SSI group had greater spasticity requiring oral baclofen or a baclofen pump [χ²(df) = 11.1 (3), p=0.01]. The SSI cohort had more cases of dehiscence and significant drainage within 3 days of surgery [χ²(df) = 27.7 (2), p<0.001]. Mean length of surgery = 7.5 hrs (SD± 3.1) for the SSI group vs. 6.1 hrs. (SD± 2.1) for controls, p=0.03. There were more intraoperative complications in the SSI group (25%) compared to the control (12.7%). The SSI cohort spent two extra days post-op in the ICU (8.4 vs. 10.2 days).

Conclusion: Risk factors for SSI in pediatric deformity surgery are increased weight, severe spasticity, incompetent wounds, and prolonged surgical time. The SSI cohort had more intraoperative complications and longer ICU stays.

Notes:
Can All Tibial Shaft Fractures Bear Weight Following Intramedullary Nailing? A Randomized Clinical Trial

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Introduction: There currently exists no consensus regarding the appropriate postoperative weight-bearing status following intramedullary nailing of tibial shaft fractures. This prospective randomized study was designed to examine the potential benefits or risks associated with postoperative weight-bearing versus non-weight-bearing. The null hypothesis was that initial weight-bearing status had no effect on outcome following tibial nailing.

Methods: Over a 2-year period 62 tibial shaft fractures (OTA Type 42) surgically treated with an IM Nail that met inclusion criteria were identified. Patients were asked to consent to randomization of their post-operative protocol. Patients were randomized to one of two groups. Group 1: Immediate weight-bearing-as-tolerated (WBAT). Group 2: Non-weight-bearing for the first six postoperative weeks (NWB). Regular follow-up was performed, including radiographs. The Short Musculoskeletal Function Assessment (SMFA) questionnaire was used to record functional outcomes at regular intervals. Patients were followed until union or until treatment failure/revision surgery. All complications were recorded.

Results: A total of 50 patients had complete follow up (27 WBAT, 23 NWB). The groups did not differ in regards to demographics, surgical implants used, injury mechanisms, wound classification and fracture patterns. There was no difference in the observed time to union between groups (23.12 weeks, 22.18 weeks). Rates of complications, including hardware failure and delayed/non-union, did not differ between groups. No incidents of loss of reduction leading to malunion were recorded. SMFA scores for all domains were similar between groups, both at six weeks postoperatively and at union.

Discussion and Conclusion: Immediate weightbearing following intramedullary nailing of tibial shaft fractures is safe and is not associated with an increase in adverse events or complications. Patients should be allowed to bear weight as tolerated following nailing.

Notes:
implementation of a classification-based treatment algorithm using the OTA classification system.

**Methods:** A classification-based treatment algorithm specifying implant selection for particular types of intertrochanteric hip fractures was implemented throughout our department. 102 consecutive patients with intertrochanteric fractures were followed prospectively (post-algorithm group). Another 117 consecutive patients who were treated immediately prior to the implementation were identified retrospectively (pre-algorithm group). OTA classification, hardware implanted, cost and perioperative complications were recorded. Comparisons were made between both groups. The algorithm was retrospectively applied to the pre-algorithm group to determine potential savings that would have resulted if the protocol was followed with these cases.

**Results:** Prior to implementation 41.9% of patients were treated with a different implant than what was prescribed by the algorithm. Under the new protocol 89% surgeon compliance was obtained. Prior to algorithm implementation total cost was $357,475 (mean: $3,055.19 ±$1,310.84) consisting of 28% SHS, 20% short IMN and 52% long IMN; compared to $255,120.50 (mean: $2,501.18 ±1,272.35) post-algorithm, consisting of 40% SHS, 35% short IMN, 25% long IMN. Patients treated after algorithm implementation had fewer complications (18.8% vs. 9.8%; p=0.096). The algorithm was applied retrospectively to the pre-algorithm group to determine the implants that should have been used (40.17% SHS, 38.46% short IMN, 21.37% long IMN), a total cost of $287,162.50 (mean: $2,454.38 ±$1,230.12) could have been obtained and $70,294.50 potentially saved. The amount of savings per case would have been approximately $600.

**Discussion and Conclusion:** Implementation of an evidence-based intertrochanteric fracture implant selection algorithm effectively reduced costs in our institutions while maintaining quality of care and less complications. These savings are independent of any special pricing arrangements or institutional discounts. This strategy has potential implications in physician “gainsharing” programs.

**Notes:**

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**The Potential Efficacy of an Anesthesiology-Driven Pre-Operative Triage Protocol for Hip Fracture Patients**

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Gordon Morewood, MD
Poovedran Saththasivam, MD
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**Introduction:** An ever-increasing requirement for efficiency is an inescapable aspect of the current US healthcare system. Empirical evidence indicates that efficient and effective preoperative management minimizes expense, risk, and delay associated with unnecessary testing or consultation that will not affect perioperative care. We sought to determine whether a defined anesthesiology-driven triage protocol might influence the incidence of consultation and testing and the time to surgery for patients with isolated low energy hip fractures.

**Methods:** A retrospective review from May 1, 2011 to April 30, 2012 identified 47 patients with 48 hip fractures. Time to incision, all pre-operative consultations, clearance testing, and postoperative complications were recorded. An anesthesiology triage protocol derived from evidence based consensus statements was then applied to determine if each patient could have been “cleared for surgery” at the time of admission.

**Results:** Forty-one of 48 hip fractures (85%) would have been cleared by the anesthesiology clearance protocol at the time of admission. For these patients, 34 specialty consults had been ordered for clearance (11 cardiology, 5 pulmonary, 1 nephrology, 1 neurology, and 15 medical clearance consults) Twenty-seven physiologic studies were performed (13 Echocardiograms, 12 head CTs, 3 pulmonary function tests). Average time to incision for the cleared group was 2.3 days (8 hrs-11.3 days). The preoperative consultations or testing did not result in significant changes to the patients’ perioperative management or outcome. Three major medical complications occurred in the anesthesiology cleared group (1 NSTEMI, 1 PE, 1 death from respiratory failure).
Discussion and Conclusion: An evidence based anesthesia driven triage protocol applied at the time of admission may have significantly reduced the use of pre-operative consultations, unnecessary advanced imaging or physiological studies, and potentially could have shortened time to surgery in hip fracture patients.

Notes:

Results: Hemipelvectomy was generally indicated for insufficient soft tissue coverage complicated by life-threatening local infection and/or a necrotic and dysvascular hemipelvis following early ligation of critical intrapelvic vasculature. Seven of the patients had acquired angioinvasive fungal infection, for which hemipelvectomy was used to treat invasion into the true pelvis. Treatment of these difficult infections involved both debridement of pelvic contents, and topical diluted bleach solutions plus local and systemic antifungals. Associated genitourinary trauma was the norm. Extended hemipelvectomy consisting of partial sacrectomy was required in three patients. Subtotal hemipelvectomy was performed in seven patients in efforts to improve sitting balance and/or prosthetic socket support or to minimize pressure ulcers over the sacrum.

Discussion and Conclusion: Trauma-related hemipelvectomy is a catastrophic injury that leaves little margin for error on the part of the treating surgeon and medical team. The high survival rate in our patients appears to have resulted from initial rapid resuscitation as well as an extremely aggressive surgical approach to gain control of local infections and achieve a viable adjacent soft tissue envelope. Our experience and management techniques may benefit the civilian surgeon confronted with high-energy open injuries to the pelvic girdle.

Notes:

Combat-Related Hemipelvectomy: Fourteen Cases, A Review of the Literature and Lessons Learned

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Benjamin K. Potter, MD

Introduction: Trauma-related hemipelvectomy is a rare, devastating and often fatal injury that poses a number of challenges to the treating orthopaedic traumatologist. Treatment of these injuries typically requires intense effort by providers from multiple services, to include orthopaedics, general surgery, urology, critical care and infectious disease. Approximately seventy cases have been described in the twentieth century. Unfortunately, we have had a unique experience with a number of combat-related hemipelvectomies over the last two and one half years.

Methods: We performed a retrospective review of our prospective trauma registry into which all our combat-injured patients are enrolled, as well as patient medical records, radiologic studies, and clinical photographs.

Notes:
of complications for patients undergoing hemiarthroplasty on clopidogrel.

**Methods:** All hemiarthroplasty patients between 2005 and 2011 were identified in our fracture registry. Patients were placed in two comparative cohorts based on use of clopidogrel anti-platelet therapy. Records were reviewed for patient demographics, American Society of Anesthesiologists score (ASA), pre and post-operative hemoglobin (Hgb), time to surgery, length of stay, bleeding events, transfusions and complications. Comparative statistical analysis was performed using Chi-Square and Student’s t-test.

**Results:** A total of 203 charts were reviewed of which 162 patients met inclusion criteria. 112 females and 50 males with a mean age of 84 years were identified. 15 of the 162 patients that met inclusion criteria were on clopidogrel therapy (9.3%). There were no significant differences between groups with regards to age, aspirin use, or time to surgery. The clopidogrel group had more comorbidities resulting in a significantly higher ASA score (4 vs. 2.8), and lower preoperative hemoglobin (11.3 vs. 12.0) compared to the non-clopidogrel group. Postoperatively, there was no significant difference identified in intraoperative blood loss, hemoglobin on postoperative days 1 to 3, or number of transfusions between groups. Patients on clopidogrel had significantly longer hospital stays (10.6 vs. 7.4 days) and a significantly increased risk of overall complications (26.7% vs. 13.6%). However there was a similar rate of wound related complications (6.7% vs. 6.1%) was seen.

**Discussion and Conclusion:** The optimal timing for hemiarthroplasty for patients on clopidogrel therapy is unclear. In this study there appears to be no significant difference with regards to bleeding or bleeding related wound complications for patients on clopidogrel therapy.

**Notes:**

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**Atypical Femur Fractures and Bisphosphonate Use: A Clinical Study**

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**Introduction:** Bisphosphonates comprise a class of osteoclast inhibitors that demonstrably decrease fracture rates in women with osteoporosis. However, recent reports have proposed a link between bisphosphonate use and atypical femur fractures. We hypothesize that patients undergoing bisphosphonate treatment will have atypical radiographic fracture features.

**Methods:** We evaluated radiographs of all operatively-treated femur fractures in women over an 18-month period. Atypical fractures were compared to typical subtrochanteric or diaphyseal femur fractures and examined with respect to age and bisphosphonate use. American Society for Bone and Mineral Research (ASBMR) criteria were used for classifying fractures. Fractures were defined as atypical if they had lateral cortical thickening compared to the rest of the bone, a transverse fracture line on the lateral cortex, and an oblique medial fracture fragment. Patient records were reviewed to determine if bisphosphonates were used.

**Results:** 435 operatively-treated femur fractures were identified. Of these, 33 fractures (8%) were either subtrochanteric or diaphyseal; all suffered low-energy injuries. Of the 33 fractures, 15 were classified as atypical, 15 as typical, and 3 as impending. The average age in the atypical fracture group was 69 years versus 82 in the typical group. This difference was significant. All patients in the atypical group were taking a bisphosphonate at the time of fracture or within the preceding year. No patients with typical fractures were taking a bisphosphonate at the time of injury.

**Discussion and Conclusion:** The link between bisphosphonate use and atypical femur fractures remains controversial. The possible relationship between bisphosphonate use and atypical fractures makes determining the subset of patients for whom there is an increased risk very important. This issue has become more urgent with the aging population in
the United States. When addressing these questions in depth, our work demonstrates that radiographs are an integral component of any subsequent study.

Notes:

Hemiarthroplasty for Undisplaced and Stable Femoral Neck Fractures

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Thomas R. Bowen, MD
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Introduction: The incidence of hip fractures in the United States and Europe is high and continues to increase. The best treatment for femoral neck fractures is still under debate. The purpose of the study was to compare the complication, reoperation and mortality rates of hemiarthroplasty and osteosynthesis in patients with impacted/stable osteoporotic femoral neck fractures.

Methods: We retrospectively compared the complication, reoperation and mortality rates between two groups which were matched in age, gender, BMI and ASA scores. All included patients sustained Garden I or II femur neck fractures. Either hemiarthroplasty or osteosynthesis was performed based on surgeon preference. Osteosynthesis was performed with three parallel cannulated screws. The minimum follow up was 24 months. All patients were over 60 years old. The primary outcomes were complications of surgery and the need for revision surgery. A secondary outcome of the study was the cost of the primary surgery.

Results: The mean age of the 98 patients in the osteosynthesis group was 82 (range, 60-104) and 80 (range, 60-90) in the 38 patients treated with hemiarthroplasty. Mean follow up was 44 ± 1.4 months (range, 24-92 months). Overall complication, reoperation and one year mortality rates were similar in both groups. Infection was significantly higher in the hemiarthroplasty group. In a logistic regression model analysis, the complication, reoperation and one year mortality rates were similar between patients over and under 80 years old, in both the hemiarthroplasty and osteosynthesis groups. Intraoperative blood loss and length of stay were significantly lower in the osteosynthesis group. The hemiarthroplasty group had a much higher cost of surgery.

Discussion and Conclusion: Hemiarthroplasty has no benefit in decreasing complications and reoperations for stable femoral neck fractures in the elderly. The costs of surgery and infection rates are higher with hemiarthroplasty as compared to osteosynthesis for these stable fracture patterns.

Notes:

What Is the Impact of Age on Reoperation Rates for Femoral Neck Fractures Treated with Closed Reduction Percutaneous Pinning and Hemiarthroplasty?

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Introduction: As the prevalence of hip fractures continues to increase, the preferred method of surgical intervention for femoral neck fractures (FNF) based on age remains a topic of debate. The primary aim of the study was to assess the effect of age on reoperation rates following FNF treated with closed reduction percutaneous pinning (CRPP) and hemiarthroplasty (HA).

Methods: A retrospective comparative study was performed at a level 1 trauma center at which electronic medi-
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Cal records and digital radiographs were reviewed for 949 FNF with minimum 2 year follow up. Age groups of 60-69, 70-79, and greater than or equal to 80 (octogenarians) were created within nondisplaced FNF treated with CRPP and displaced FNF treated with HA. For the primary outcome of reoperation based on age, Kaplan-Meier models were built and analysis applied.

Results: Three hundred thirty-four fractures were nondisplaced treated with CRPP, and 615 were displaced managed with HA. Overall, a total of 98 patients (10.33%) required reoperation. Increasing reoperation rates for CRPP was seen with each subsequent age group. The opposite was seen with HA in which increasing age groups showed lower reoperation rates. The relationship of reoperation rate with surgical choice and age group was found to be significant. In the octogenarian group, CRPP reoperation rates were significantly higher than HA at 6-month, 1-, 2-, and 3-year follow-up.

Discussion and Conclusion: Patients greater than or equal to 80 years old undergoing closed reduction percutaneous pinning showed a high reoperation rate and consideration of primary hemiarthroplasty should be made for nondisplaced femoral neck fractures in the octogenarian population.

Notes:

Nature’s Wrath – The Effect of Daily Weather Patterns on Postoperative Pain Following Orthopaedic Trauma

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Roy I. Davidovitch, MD
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Introduction: The effect of weather on patients’ pain and mobility is a frequent complaint in musculoskeletal care. The aim of our study was to investigate the influence of daily weather conditions on patient reported pain and functional status.

Methods: We examined 2,369 separate outpatient visits of patients recovering from operative management of an acute tibial plateau fracture (n=332), an acute distal radius fracture (n=1,179), or chronic fracture nonunion (n=858). Pain and functional status were assessed using validated surveys. For each visit date, the mean temperature, difference between mean temperature and expected temperature based on a 17 year average, dew point, mean humidity, amount of rain, amount of snow, and mean barometric pressure were recorded. All weather data was specific to the zip code of the outpatient medical office where patients were seen, and obtained from a publically available almanac. Statistical analysis was run to search for correlations.

Results: There was a significant correlation between low barometric pressure and increased pain for all patient visits (p=0.007) and for patients at 1-year follow-up only (p=0.005). Barometric pressure below one standard atmosphere (29.92 in) was highly associated with increased pain for patients at 1-year follow-up (p=0.006). At one year follow-up, high temperature, high humidity, and high dew point also were significantly associated with increased pain (p=0.021, p=0.030, p=0.033 respectively). Weather conditions were not associated with patient reported functional outcomes.

Discussion and Conclusion: While pain in the immediate postoperative period is most likely dominated by incisional and soft tissue injuries, as time progresses weather clearly impacts patient pain levels. Variation in patient reported pain scores due to weather conditions should be anticipated. Patients may be counseled that their symptoms may worsen in association with weather conditions.

Notes:
All-Metal Distal Radius Hemiarthroplasty Combined with Proximal Row Carpectomy

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A. Lee Osterman, MD
Randall W. Culp, MD

Introduction: Patients who desire more motion during physical activity but would otherwise undergo total wrist fusion or total wrist arthroplasty may be appropriate candidates for distal radius hemiarthroplasty combined with proximal row carpectomy (PRC). In this report, we present our outcomes using an all-metal distal radius component.

Methods: A retrospective chart review was completed for 28 patients who underwent primary wrist hemiarthroplasty combined with PRC or revision hemiarthroplasty using the metallic distal radial component of a prosthesis. There were 11 females and 17 males, with a mean age of 61 years (range, 42-81) at the time of surgery. Specific diagnoses of patients undergoing this procedure included scapholunate advanced collapse, scaphoid non-union advanced collapse and inflammatory arthritis, post-traumatic arthritis. The mean number of previous procedures was 1 (range, 0-3). Preoperative wrist flexion, extension and grip strength were compared to the postoperative values. Complications were noted.

Results: Mean clinical follow up duration was 0.9 years (range, 0.1-2.0). The wrist flexion-extension arc was 71º preoperatively and became 53º post-operatively, p=0.005, n=25. Grip strength of the affected side was 57% of the opposite hand preoperatively and became 65% postoperatively, p=0.354, n=14. One patient had total wrist arthrodesis, 3 patients developed painful ulnar positive variance, painful impingement of the implant on the capitate and hamate developed in 5 patients, this lead to erosions or cysts in 2 patients. Complex regional pain syndrome developed in 2 patients.

Discussion and Conclusion: Short-term outcomes of the all-metal distal radius hemiarthroplasty combined with PRC reveal the maintenance of a functional arc of wrist motion and a trend towards improved grip strength. However, persistent pain and complications occurred in a relatively high proportion of patients. Longer follow up and subgroup analysis may help to better define the most appropriate candidates for this procedure.

*The FDA has not cleared this drug and/or medical device for the use described in the presentation. (Refer to page 54).

Notes:

Does the Use of an Inferiorly Offset Glenosphere in Reverse Shoulder Arthroplasty Reduce Scapular Notching? A Radiographic and Functional Outcome Analysis

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Introduction: Scapular notching is a common complication after reverse shoulder arthroplasty (RSA) and has been associated with poor clinical outcomes. Factors associated with notching include neck-shaft angle and glenosphere position. Recently, we began using a reverse shoulder prosthesis with an eccentric glenosphere that allows for inferior offset. The purpose of this study is to evaluate the incidence of notching with this prosthesis and its effect on clinical outcome.

Methods: We retrospectively reviewed the charts of the first 100 patients who underwent RSA with the eccentric
glenosphere. 82 were available for follow up and radiographic analysis. Scapular notching was assessed using standard AP radiographs of the glenohumeral joint according to the Nerot classification system. Two independent observers evaluated all radiographs. The presence of radiolucent lines was also evaluated. Both range of motion (ROM) and constant scores were obtained on all patients with > 2yrs of follow-up.

**Results:** Average age (74: range 61-91) and average follow-up (18.3 months: range 12-35mos). According to the Nerot Classification, 73 or 89% had no notching, 5 or 6% had grade I, 2 or 2% had grade II; and 2 or 2% had grade III. Overall presence of notching was 10% and correlated to the amount of inferior offset. There were no radiolucent lines around the prosthesis. Furthermore, no intraoperative complications occurred with the eccentric glenosphere. Both range of motion and constant scores significantly improved in all patients from pre-op to final follow-up (31.3 to 74.2). No significant differences in ROM and functional outcome were seen between the notching and no notching groups.

**Discussion and Conclusion:** Inferior offset glenosphere will reduce the incidence of scapular notching in RSA. This was particularly true when the glenosphere was maximally offset inferiorly. In the short term, notching does not influence ROM or functional outcome.

**Notes:**

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Complication Rates in Elbow Arthroscopy

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Charles Cassidy, MD

**Introduction:** Elbow arthroscopy has traditionally been regarded as having a relatively high complication rate when compared to knee or shoulder arthroscopy. This is based largely on a landmark study by Kelly et al. from the Mayo clinic. That study reviewed the elbow arthroscopies performed at that institution from 1980-1998. Since that time, elbow arthroscopy has become a more common procedure. Our study is designed to determine if complication rates have changed as the procedure has become more common.

**Methods:** We performed a retrospective review of elbow arthroscopies performed by a two surgeons at two hospitals from January 1st, 2001 to December 31st, 2011. 363 patients were identified and adequate data was available for 336. Average follow up was 145 days. The most common diagnoses included epicondylitis, osteoarthritis, inflammatory arthritis, synovitis, plica, loose bodies, OCD lesions, and contractures.

**Results:** Serious complications occurred after 2% of arthroscopies (two patients with loss of motion greater than 30 degrees and three patients with neurologic injury). Minor complications occurred after 21% of arthroscopies (42 with motion loss of 30 degrees or less, four portal related seromas, one portal site with drainage, one superficial infection treated with antibiotics, and six temporary paresthesias). In the 42 patients with a motion loss of 30 degrees or less, the average loss was 10.6 degrees.

**Conclusions:** The complication rates for elbow arthroscopy in this study were found to be higher than in the study by Kelly et al. However the types of complications have shifted. We experienced no joint infections, minimal portal drainage problems and minimal nerve related complications. The majority of our complications were related to post-operative motion loss. This suggests that while the arthroscopic techniques may have become safer and more popular, surgery about the elbow still carries significant risks.

**Notes:**
Arthroscopic Trapeziectomy with Suture Button Suspensioplasty: Moving from an Open to an Arthroscopic Surgery for All Stages of Symptomatic Carpo-Metacarpal Arthritis

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Randall W. Culp, MD

Introduction: The hypothesis is that arthroscopic trapeziectomy with button suspensioplasty (ATBS) for all stages of symptomatic thumb osteoarthritis is a safe, minimally invasive technique that achieves acceptable results in terms of pain relief and post-operative pinch strength.

Methods: All charts of patients consecutively treated with partial or complete ATBS at one surgical center, from January 2010 to December 2012, were retrospectively reviewed. One senior hand surgeon performed all cases.

Results: One hundred fifty-seven cases of ATBS were performed in 145 patients. Ninety-seven cases involved arthroscopic hemitrapeziectomies and 60 involved complete arthroscopic trapeziectomies. There were 41 males and 104 females with a mean age of 60. Thirty seven percent of the cases were graded as stage IV, 50% as stage III, and 13% as stage II base of thumb arthritis. Means for tourniquet and operation room times were respectively 32 minutes and 48 minutes. The median follow-up duration was 14 weeks. The mean preoperative key pinch strength of the affected over the unaffected side was 92 % pre-operatively compared to 95% post-operatively. The median of the delay between the 2 procedures was 6 months. Revision arthroplasty was required in 4 out of 157 cases due to the progression of disease with involvement of the triscaphal joint. All other patients experienced improvements in pain and were satisfied with treatment. No post-operative carpo-metacarpal (CMC) instability was noticed. Two post-operative complications developed (1.3%): one patient presented with osteomyelitis of the 1st and 2nd metacarpal bones and the device was removed 6 weeks post-operatively. In the 2nd case, the button was found to be too prominent over her 2nd metacarpal dorsally and the device was removed.

Discussion and Conclusion: ATBS is a novel minimally invasive procedure used to treat symptomatic thumb CMC arthritis of all stages. ATBS is associated with maintenance of pinch strength, joint stability, pain relief and satisfaction.

Notes:

Posterior Interosseous Nerve Localization in the Proximal Forearm — A Patient Normalized Localizing Parameter

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Andrew Deane
Srinath Kamineni, MD

Introduction: Accurately localizing the posterior interosseous nerve in the proximal forearm has diagnostic, therapeutic, and safety implications. However, there are significant variations in individual anatomy, which have traditionally posed problematic for defining useable parameters. We attempt to provide a non-invasive, patient-normalized localizing parameter of the posterior interosseous nerve in the proximal forearm.

Methods: Sixty-three cadaveric upper extremities were studied, with minimally disruptive dissection techniques. We measured the transepicondylar distance (TED), posterior interosseous nerve distance from the lateral epicondyle in three forearm positions (neutral, pronation, and supination), and the posterior interosseous nerve width. Two individuals performed the measurements using a digital caliper on two separate occasions, with inter-observer and inter-occasion blinding. The results were analyzed with Wilcoxon-Mann-Whitney test for paired samples as well as a significance test (with normal distribution). This parameter has also been utilized in seven patients during a two year period, for clinical validation.

Results: In a pronated forearm, the posterior interosseous nerve was identified within two confidence intervals of 1
TED in 95% of cases (range 0.7-1.3 TED). In a neutral position, it was within two confidence intervals of 0.84 TED in 95% of cases (range 0.5-1.1 TED). In the supinated position, it was within two confidence intervals of 0.72 TED in 95% of cases (range 0.5-0.9 TED). Significant differences existed between TEDs comparing left to right side of the same person, p-value 0.03, but no differences existed between observers. During clinical decompression of the PIN in seven patients, an incision length of 0.5-1.1 TED centered over the 84% TED in a neutral forearm was always able to locate the nerve within the extent of the surgical incision.

Conclusions: We present a normalizing parameter that allows localization of the crossing point of the posterior interosseous nerve with a line interconnecting the lateral epicondyle and the radial styloid. The mean posterior interosseous nerve distance from the lateral epicondyle was 100% of the transepicondylar distance (TED) in a pronated forearm, 84% in neutral, and 72% in supination. Predictive accuracy was highest when the arm was in a supinated position, and in all cases the majority of specimens (90.47% – 95.23%) are within 2 cm of the forearm position-specific percentage of TED. The non-invasive and accurate localization of the posterior interosseous nerve in the proximal forearm will aid in diagnosis, injections, surgical approaches, and understanding neurological symptoms in the forearm.

Factors Affecting Hospital Charges After Shoulder Arthroplasty: An Evaluation of the National Inpatient Sample Database

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E. Scott Paxton, MD
Mitchell Maltenfort, PhD
Joseph A. Abboud, MD

Introduction: The number of shoulder arthroplasties (SA) performed in the United States increases yearly, with a larger rate increase experienced since the FDA approval of the reverse shoulder arthroplasty in 2003. As reimbursements for healthcare decline, it is imperative to identify specific variables that increase the costs associated with these procedures.

Methods: The National Inpatient Sample (NIS) Database was queried (1993 – 2010) to evaluate total hospital charges for SA. Using a multivariate analysis, the effect of comorbidities, peri-operative complications, patient demographics, hospital type, and location were examined. Patient demographics included gender and race. Hospital types were defined by the NIS database by setting (urban or rural) and size (small, medium, and large). The outcome measured was total inpatient hospital charges.

Results: Hospital charges for total shoulder arthroplasty were fairly consistent from 1993 to 2001 (1.97% increase per year) but then increased steadily through 2010 (7.84% increase per year). Gender, race, and obesity were not associated with differences in hospital charges. However, diabetics who underwent SA did demonstrate significantly increased hospital charges by 3.16% (1.84% - 4.50%, 95% CI). In addition, peri-operative complications did cause a significant increase in total inpatient hospital charges for SA 62.89% (40.61%-88.71%, 95% CI). Regionally, the West and South had the highest increase in charges, 52.13% (45.83% - 58.71%, 95% CI) and 7.37% (3.52% - 11.36%, 95% CI), respectively. Larger hospitals and private urban hospitals also showed higher charges (7.72% (3.59% - 12.03%, 95% CI) and 7.49% (4.65% - 10.41%, 95% CI), respectively), than small, urban academic hospitals.

Discussion and Conclusion: There is variability in the hospital charges for patients undergoing SA. The different factors related to these variable costs are multifactorial and include medical comorbidities, patient demographics, and regionalization. As the future of healthcare continues to evolve, being aware of factors which increase cost are important to note by practitioners, legislators, insurance administrators, and hospitals.

Notes:
Radiation Exposure to the Hand Surgeon’s Hands: A Practical Analysis

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Asif M. Ilyas, MD
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Charles F. Leinberry, MD

Introduction: With imaging advances in orthopaedics and the advent of surgical centers, surgeons often utilize fluoroscopy units from different manufacturers, which have different specifications. In hand surgery, mini C-arm fluoroscopy has become increasingly common, decreasing use of the standard C-arm. In addition, hand surgeons operate in close proximity to the unit. Current literature shows disagreement with respect to which unit is safer. Our goal was to look at the difference in exposure to the hand surgeon’s hands.

Methods: Two surgeons wore ring dosimeters on their non-dominant ring finger during operative cases of the wrist, hand, and fingers. One surgeon used the standard C-arm, while the other used mini C-arm fluoroscopy. The data collected included type of case, fluoroscopy time, radiation emitted, fluoroscopy time per case, dose per case, and dose by time. We also looked at surface dose exposure reports from the rings.

Results: On preliminary analysis, we examined 30 cases (15 per cohort) for which we had received the ring dosimeter exposure data, thus completing the data for those cases. Our results show that the mean radiation dose for the mini C-arm was 38.53-mGy/case, while the mean for the standard C-arm was 0.90-mGy/case. This shows a statistically significant difference. There was also a significant difference in fluoroscopy time, with the mini C-arm being used for roughly twice the time of the standard C-arm.

Discussion and Conclusion: In our practical model, our preliminary analysis shows that the mini C-arm is associated with a significantly higher radiation dose per case than the standard C-arm. This increased exposure is more than can be accounted for by the time difference between cases. Looking forward, we will analyze the dose delivered to the dosimeters themselves. In the interim, due to the non-trivial radiation exposure noted, we recommend using techniques to minimize intraoperative radiation exposure.

Notes:

Large Hill-Sachs Lesion: A Comparative Study of Patients Treated with Remplissage or Isolated Bankart Repair

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Min Jung Park, MD, MMSc
Clare Zhang, MD
John D. Kelly IV, MD
G. Russell Huffman, MD, MPH

Introduction: While biomechanical data supports the role of Remplissage augmenting a Bankart repair with large Hill-Sachs lesions, there is little comparative clinical data comparing Bankart repair alone to the addition of a Remplissage in this population of instability patients. The purpose of our study was to compare patients whom all had significant humeral head lesions diagnosed on MRI who underwent either isolated Arthroscopic Bankart repair or Remplissage based on two different surgeons’ operative protocols.

Methods: Of our initial 289 instability patients treated surgically from 2006-2011, we performed a retrospective comparison study of 15 isolated Arthroscopic Bankart repairs and 10 Remplissage patients all with identified large Hill-Sachs lesions. The average follow up was 41.99 months (26.3-59.8) in the isolated Bankart repair group and 31.55 months (24.1-39.9) in the Remplissage group. We used MRI for measurements and selection criteria, which were all done by a musculoskeletal radiologist. Both WOSI and DASH scores were obtained at follow-up.

Results: The average Hill-Sachs lesion volume was 306.19 mm³ in the Bankart repair group and 283.79 mm³ in the Remplissage group. All patients had a glenoid deficiency of less than 20%. The failure rate for the isolated Bankart repair group was 8 out of 15 patients (53.3%) with 3 dislocations and 5 subjective subluxations. For the Remplissage group the failure rate was 2 out of 10 patients (20.0%) with 1 dislocation and 1 subjective subluxation. Average WOSI scores were 73.61 in the Bankart repair group and 79.54 in the Remplissage group. For DASH scores the average Disability/Symptoms Scores were 15.76 for Bankart repair group and 12.05 for Remplissage patients.

Discussion and Conclusion: In our cohort of patients, in comparison to isolated Bankart repair, Remplissage was a superior option for recurrent instability patients with large
Hill-Sachs lesions as seen by diminished failure rates and improved outcome scores.

Notes:

Cost Effectiveness of Reverse Total Shoulder Arthroplasty Versus Hemiarthroplasty for Proximal Humerus Fractures

Shahin Sheibani-Rad, MD
A. George Dass, MD

Introduction: Cervical radiculopathy is a common problem in society that causes significant disability. Cervical disc arthroplasty (CDA) is increasingly being used as an alternative to anterior discectomy and fusion (ACDF). We set out to further evaluate the outcomes of cervical disc arthroplasty.

Methods: We performed a retrospective review of 176 consecutive patients undergoing CDA at a single, military tertiary medical center from 2008 to 2012. All construct types (1-level CDA, 2-level CDA/ACDF hybrid, and multi-level CDA) were included for review.

Results: Of the 176 patients, 40 were female (22.7%) with an average age of 41.6±8.1 years. Surgical indication was radiculopathy in 141 patients (84.4%), myelopathy in 13 patients (7.8%), and both in 10 patients (6.0%). Average follow-up was 8.5±7.6 months. 111 patients (63.1%) underwent single-level CDR. CDR/ACDF hybrid constructs were used in 52 patients (29.5%) and 13 patients (7.4%) underwent a two-level CDR. The most frequently addressed levels were C6-7 (42.0%) and C5-6 (39.6%). At most recent follow up, average CDA range of motion was 7.46 degrees (±3.6 degrees). 94.5% of patients experienced complete resolution of their pre-operative symptoms and 93.6% of patients returned to full activity. 36 patients (21.8%) experienced persistent posterior neck pain. Other complications included one superficial infection, five recurrent laryngeal nerve injuries and 18 patients reporting persistent dysphagia.

Conclusion: This is the largest non-sponsored single center study of cervical disc arthroplasty. Our data demonstrates relief of pre-operative symptoms (94.5%) and return to full activity (93.6%) with an average follow-up of 8.5 months. There was a low complication rate without device or implant related complications. Arthroplasty continues to be a safe and reliable option in treating patients with cervical radiculopathy or myelopathy.

Notes:

Risk Factors of Surgical Site Infection Following Total Joint Arthroplasty

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Background: Surgical site infection (SSI) is a major complication following total joint arthroplasty (TJA) with substantial morbidity and huge economic burden on health care system. The present study aims to identify some predictors of SSI following TJA.

Methods: Between April 2010 and June 2012, 2718 total hip arthroplasty (THA), 2549 total knee arthroplasty (TKA), 516 revision THA and 328 revision TKA were performed at our institution. Patients developing SSI were identified using the infection control database of our hospital. SSI cases were captured by infection control nurses based on the
CDC definition. SSI cases with index surgery out of our center were excluded.

Results: Of all performed TJA, SSI developed in 80 cases. The highest rate of SSI was observed in revision TKA (4.57%) followed by revision THA (1.94%). Multivariate logistic regression was used to examine potential predictors of SSI, including age, gender, body mass index, unadjusted Charlson comorbidity index, month of surgery, type of surgery, and pre-operative measurements of serum albumin, serum glucose and hemoglobin. Among these, the predictive factors were found to be higher Charlson Index (OR = 1.21/point, 95% CI = 0.71-0.98), lower preoperative hemoglobin (OR = 0.84/point, 95% CI = 0.71-0.98), male gender (OR = 1.94, 95% CI = 1.17-3.21) and performance of a revision TKA (OR = 3.53; 95% CI = 1.22-10.21). The C-statistic of the model was found to be 0.6851 after bootstrap correction for model optimism.

Conclusions: This study identified some risk factors of SSI that can be used to prevent or reduce rate of SSI. Low pre-operative hemoglobin level is one of the modifiable risk factor of SSI that should be corrected before surgery to reduce likelihood of postoperative SSI.

Notes:

Risk Factors for Nasal Colonization by Staphylococcus Aureus in Patients Undergoing Spinal Fusion or Joint Arthroplasty

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Colleen Cunningham, BS
Saqib Hasan, MD
Lorraine Hutzler, BS
Michael Phillips, MD
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Introduction: Staphylococcus aureus nasal colonization is a risk factor for surgical site infection. We conducted a retrospective case-control study to identify criteria that identify patients at risk for nasal colonization by MRSA and MSSA.

Methods: The study consisted 1699 consecutive patients who underwent a spinal fusion or total joint arthroplasty surgery at our institution from March 1, 2011 through March 1, 2012 and who attended our preadmission testing clinic. Each patient’s anterior nares were swabbed and cultured for S. aureus. A case-control study was performed in which our case subjects were patients with positive culture for MSSA or MRSA, and controls were patients with negative culture. Univariate and multivariate logistic regression estimated odds ratios were used to determine potential predictive risk factors for colonization.

Results: Of 1699 patients, 314 (18.5%) had positive cultures, of which 268 (15.8%) had MSSA and 46 (2.7%) had MRSA. Univariate analysis showed Caucasian males with asthma were at risk for colonization. Males had a 2-fold greater risk of both MRSA and MSSA colonization compared to females. Multivariate analysis showed obesity (BMI above 30) combined with male gender or asthma is a significant risk factor for both MRSA and MSSA colonization. Obese to morbidly obese (BMI above 30) patients with asthma had a 2.6-fold greater risk of colonization with MRSA.

Discussion and Conclusion: Our study is the first to examine potential risk factors for staphylococcus nasal colonization in orthopaedic surgery patients undergoing spine and total joint surgery. Multivariate analysis showed obese patients with asthma had a 2.6-fold increase in MRSA colonization. A small (0.5-fold increase), albeit statistically significant, increase in risk of MSSA colonization was found for males with BMI above 30. The identification of obesity and asthma as risk factors for MRSA colonization may help decolonization programs target patients with these risk factors for treatment prior to surgery.

Notes:
The Potential Role of Urinary Tract Colonization on the Development of Periprosthetic Infection. An Observational Study

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Ari Brandsdorfer, MS
Glenn J. Kerr, MD
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**Introduction:** Although urinary tract infections have been proposed as a risk factor for periprosthetic joint infection (PJI), the evidence is still controversial. In this observational study, we sought to evaluate the possible link between pathological bacterial colonization of the urinary tract and development of subsequent PJI.

**Patients and Methods:** Utilizing a cohort of 608 patients with PJI revised at our institution, we retrospectively analyzed urine cultures performed prior to index surgery as well as those performed in proximity to the diagnosis of PJI. Correspondence between the infecting bacteria was considered when the same organism strain was isolated both in the urine sample and in the periprosthetic tissues.

**Results:** We identified 55 patients (9%) with urinary culture done at the time of diagnosis of PJI as well as cultures isolating the PJI causative organism. Six cases (10.9%) had correspondence between the infecting bacteria. The responsible organisms were: *Escherichia coli* (2 cases), *Pseudomonas aeruginosa* (1 case), *Methicillin resistant Staphylococcus aureus* (MRSA) (1 case), *Staphylococcus Coagulase Negative* (1 case) and *Staphylococcus aureus* (1 case). A multivariate analysis showed that female gender (OR: 4.7 [CI: 2.5-8.6], p<0.01) was the only factor found to be associated with colonization of the urinary tract that may have led to subsequent PJI. Interestingly, none of the patients with pathological urinary tract colonization before the primary arthroplasty had correspondence to the PJI organism.

**Discussion:** We found observational proof to propose urinary tract colonization as an additional pathophysiological factor that may contribute to development of PJI. Our data suggest that urinary tract colonization, when diagnosed in the proximity of PJI diagnosis, may play a role in the development of culture-positive PJI in one over ten cases.

Apparently, a positive urine culture prior to the primary arthroplasty does not have any role in the development of future PJI.

**Notes:**

Optimal Irrigation and Debridement of Infected Total Joint Implants with Chlorhexidine Gluconate Solution

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Evan M. Schwechter, MD
Sun Jin Kim, MD
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**Introduction:** Acute periprosthetic joint infections (PJI) have been treated with irrigation and debridement (I+D) and polyethylene exchange with varying success. A previous study at our institution demonstrated that scrubbing an MRSA-coated titanium disk with chlorhexidinegluconate solution achieved superior biofilm eradication compared to scrubbing with alternative solutions. However, available literature suggests potential soft tissue damage using standard 4% chlorhexidinegluconate solution. The current study aimed to identify a minimum chlorhexidinegluconate concentration for effective bacteria eradication of an in vitro PJI model.

**Methods:** MRSA biofilm was grown on titanium disks using a clinically isolated MRSA strain in a liquid culture. Groups of disks underwent standardized irrigation with normal saline and scrubbing with either a control dry scrub brush or with a 4%, 2%, 1%, 0.5%, or 0.25% chlorhexidine gluconate solution-soaked brush. MRSA colonies were counted using the colony-forming units (CFUs) remaining on the disks following simulated I+D. The procedure was repeated with a 24-hour reincubation period prior to CFU counting.
Results: A significant decrease in CFU was noted in all disks prior to reincubation when compared to the control group. After reincubation, a significant decrease in CFUs from the control group was found in the 4% and 2% groups only. The 2% concentration chlorhexidinegluconate solution was the lowest effective concentration to eradicate MRSA colonies prior to and following reincubation.

Conclusion: This study demonstrated that I+D of infected titanium disks simulating PJI with 4% chlorhexidine gluconate solution was more effective at treating MRSA biofilm than dry scrubbing alone. Moreover, we were able to decrease the chlorhexidine gluconate concentration to a 2% solution while still maintaining a significant decrease in CFUs from the control group. The theoretical benefit of using a lower concentration chlorhexidine gluconate solution on local tissues favors progressing with further studies utilizing 2% chlorhexidine gluconate solution.

Notes:

Changes in Mechanical Properties of Hand Mixed Chemotherapy Bone Cements After Drug Elution

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Steve DeFroda, BS
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Solomon P. Samuel

Introduction: Chemotherapeutic bone cements can potentially prevent tumor recurrence after resection. Other benefits include a lower systemic side effect profile and a decreased dosage of synergistic radiation therapy. Currently there are no commercially available chemotherapeutic bone cements. Cements can be combined with soluble fillers such as polyethylene glycol (PEG) to optimize drug elution. Previous studies have investigated the mechanical properties of bone cement in its dry state, but the exact change in the mechanical properties of bone cement after drug/soluble filler elution is largely unknown. This study investigated the change in mechanical properties of these hand mixed bone cements after one year of storage in a drug elution medium.

Methods: Three cements were customized with varying amounts (0–50%) of PEG and chemotherapy agents (methotrexate or doxorubicin). Bone cement specimens were molded in the form of cylinders and were stored in a saline solution for one year. After one year, the samples were tested in compression at a cross head speed of 1 mm/min until failure.

Results: The modulus and compression strength of bone cements decreased as the percentage of soluble filler increased. Although soluble filler elution weakened the mechanical properties of these customized bone cements, Cement 2 and Cement 3 retained their original mechanical properties better than Cement 1.

Discussion and Conclusion: The combination of chemotherapeutic bone cements with soluble fillers enhances drug elution but at the expense of mechanical properties. The mechanical properties of three commercially available bone cements each behaved differently despite having the same combination of soluble filler and drug. This variation between commercially available bone cements makes it difficult to predict the rate of drug elution or changes in mechanical properties of hand mixed chemotherapy bone cements. This elucidates the need for well characterized commercially available bone cement optimized for chemotherapy drug delivery.

*The FDA has not cleared this drug and/or medical device for the use described in the presentation. (Refer to page 54).

Notes:

Effects of Articulating and Static Spacers on Mental Health During Interim Period in Two Staged Revision Total Knee Arthroplasty for Periprosthetic Joint Infection

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Su Chan Lee, MD
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Introduction: Although two-stage revision knee arthroplasty with antibiotic spacer has become the gold standard...
for treating periprosthetic joint infection (PJI), there is still controversy regarding the use of articulating versus static spacer. This study investigate whether patients treated with articulating spacer will have better mental health scores than patients treated with static spacer.

**Methods:** From February 2011 to March 2012, Fourteen knees were treated with articulating spacer and twenty-one knees with static spacer. There were 31 of females and 3 of males in each group. Hospital anxiety and depression scale (HADS, HADS-A: Anxiety subscale of HADS, HADS-D: Depression subscale of HADS), Visual Analogue Scale (VAS), Short-form-36(SF-36, only surveys of mental health component) were compared between 2 groups.

**Results:** In the articulating spacer group, HADS-A and HADS-D significantly improved from 15.0 and 14.0 at the pre-implant removal to 8.4 and 7.8 at 4 weeks post-implant removal. In the static spacer group, HADS-A and HADS-D at pre-implant removal was 14.2, 12.8 and significantly improved to 9.0, 9.1 at 4 weeks post-implant removal, respectively. HADS of static spacer group at 4 weeks post-implant removal was higher than in the articulating spacer group, but statistical significant differences was not observed.

**Discussion and Conclusion:** Although articulating spacer group and static spacer group all showed remarkable psychological improvement at 4 weeks post-implant removal, both groups still showed nearly the same anxiety and depression symptoms during the interim period regardless of the type of cement spacer utilized. The results appear to suggest that that the temporal nature of spacer treatment and the need for further definitive surgery seem to affect mental health scores equally in all patients irrespective of the type of spacer utilized.

**Notes:**

**Diagnosis of Periprosthetic Joint Infection in Medicare Patients: The Role of Multicriteria Decision Analysis**

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**Introduction:** In the setting of finite healthcare resources, developing cost-efficient strategies for diagnosis of periprosthetic joint infection (PJI) is paramount. The aim of this study is to determine the best diagnostic strategy for knee and hip PJI among Medicare patients, considering benefits, opportunities, costs and risks (BOCR) through multicriteria decision analysis (MCDA).

**Methods:** The Musculoskeletal Infection Society (MSIS) definition of PJI was employed for our study. Four diagnostic strategies comprising eight different tests were evaluated. MCDA was conducted in two stages: creation of a balance sheet followed by an analytic hierarchy process (AHP) that involved only the efficient diagnostic strategies. They were compared in terms of BOCR utilizing a preclinical model that involved a Medicare patient seen in the ambulatory setting.

**Results:** The efficient strategies for the diagnosis of PJI in both hip and knee models were: 1) Screening with serum markers (ESR/CRP) followed by arthrocentesis in those positive cases, 2) immediate arthrocentesis, and 3) serum markers requested simultaneously with arthrocentesis. The AHP model showed that screening strategy with serum markers followed by arthrocentesis in those positive cases is the best diagnostic strategy in hip (normalized priority value: 0.487) and knee (normalized priority value: 0.490). Sensitivity analysis revealed that regardless of the importance allocated to the criterion benefits, opportunities or risks, the order in which the diagnostic strategies were ranked is not affected. However, if the priority allocated to costs is >55% in knees or >54% in hips, the ranking is modified.

**Conclusion:** The categorical PJI diagnostic criteria issued by the MSIS allow the use of MCDA to prioritize different diagnostic strategies. After considering the BOCR of the efficient strategies, our preclinical model supports the AAOS recommendations regarding the use of serum ESR/
CRP before arthrocentesis as the best diagnostic strategy for PJI among Medicare patients.

Notes:

Transfer of Patient Care Between Stages of a Two-Stage Exchange for Chronic Periprosthetic Joint Infection Leads to Inferior Outcomes

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Andrew A. Freiberg, MD
Hany Bedair, MD

Introduction: The two-stage exchange algorithm is the current gold standard for the management of chronic PPJI. The purpose of the study was to evaluate the impact of having the first stage (resection arthroplasty +/- spacer) and second stage (re-implantation) performed at different institutions.

Methods: Patients having received their initial resection at an outside hospital and their subsequent care at our institution were identified. These patients were then matched (2:1) with a similar cohort that had received both stages at our institution. We compared patient characteristics, microorganism profile, total number of procedures performed, duration of treatment and final outcome between groups. Student’s T-tests and chi-square tests were used for continuous and categorical variable, respectively, with a p-value less than 0.05 considered as significant.

Results: Eighteen patients (6 THA, 12 TKA) were identified as having undergone the first debridement/implant removal stage at an outside hospital and then subsequent care at our institution (study group) were compared to 36 matched controls that had received both stages at our institution (control group). We compared patient characteristics, microorganism profile, total number of procedures performed, duration of treatment and final outcome between groups. Student’s T-tests and chi-square tests were used for continuous and categorical variable, respectively, with a p-value less than 0.05 considered as significant.

Results: Eighteen patients (6 THA, 12 TKA) were identified as having undergone the first debridement/implant removal stage at an outside hospital and then subsequent care at our institution (study group) were compared to 36 matched controls that had received both stages at our institution (control group). There were a significantly higher number of procedures in the study group compared to the control group (44.4% vs. 77.8%).

Discussion and Conclusions: The management of chronic PPJI is complex. This study suggests that patients’ receiving all of their care for chronic PPJI at a single institution leads to fewer surgeries, shorter treatment times, and more favorable outcomes.

Notes:

Acute Periprosthetic Infection in TKA: Keep the Implant or Take It Out?

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Jesus M. Villa, MD
Mark D. Rossi, PhD, PT

Introduction: Periprosthetic joint infection (PJI) is a feared complication that affects approximately 1-2% of patients undergoing total knee arthroplasty (TKA). Irrigation and debridement with implant retention (I&D), immediate implant exchange, and two-stage revision TKA have all been utilized to treat this condition. Recent reports have condemned the use of liner exchange in early infections. Our objective was to assess the results of I&D in a single surgeon’s hands after an early infection.

Methods: 28 patients (13 women) who underwent I&D for early infection were retrospectively studied. The mean age was 67 years (range, 32–87). Patient perceived outcomes, clinical scores and range of motion were assessed during follow-up. Success was defined as implant retention accompanied by pain relief and adequate function. The mean follow-up was 4 years (range: 20–104 months).

Results: 18 patients (64%) were successfully treated after aggressive I&D; additional I&Ds (range, 1–2) were required in 5 of them. All postoperative outcomes improved at the latest follow-up in the successfully treated patients. Seven patients had to undergo resection and reimplantation due to persistent pain and/or functional impairment, and 67% had a successful outcome after it.
Discussion and Conclusion: Implant retention with aggressive I&D is a reasonable treatment option for acute TKA infections, it yields good relief of pain and acceptable functional outcomes. However, the results of a two stage procedure are inferior after doing a liner swap.

Notes:

Selection Criteria and Early Peri-Operative Outcomes of Minimally Invasive Transforminal Interbody Fusion in the Outpatient Setting

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Sina Pourtaheri, MD
Arash Emami, MD

Introduction: Minimally invasive transforminal lumbar interbody fusion is a novel, safe and effective technique for achieving arthrodesis in treating lumbar degenerative disorders. This procedure is gaining popularity as an outpatient procedure due to decreases in blood loss, infection, surgical time, length of stay, and overall cost. The purpose of this study is to assess the early peri-operative outcomes and overall safety of this procedure in an outpatient setting.

Methods: This is a retrospective comparative cohort study of consecutive patients undergoing MIS-TLIF. Patients with clinical and radiographic records from the 6 week peri-operative were included. Patients were divided into two groups; Group 1: MIS-TLIF in outpatient facility, Group 2: MIS-TLIF post-operative hospital observation. Early post-operative complications were quantified and stratified into categories: 1. wound related 2. infection 3. neurologic injury 4. Implant related and 5. Vascular injury. Multiple regression analysis was performed to determine the independent predictors of post-operative complications.

Results: Ninety-two patients were included in the analysis. Fifty-three patients were males and 39 were females, with mean age of 50 years (range 21-76). Seventy-six patients underwent single level procedures, 17 underwent two levels procedures. 73 patients underwent an index procedure (79%); 19 patients had revision surgery (21%). No patients from group 1 were transferred to an in-patient facility post-operatively. Overall post-operative complications between the study groups were not statistically different. Six (6.5%) required surgical revision; 4 (66%) were implant-related, one infection, one durotomy. Revision rates were similar for both groups (outpatient 1/19; inpatient 5/73). Increased surgical time, history of diabetes mellitus and revision surgery trended towards increased peri-operative morbidity. Patient age was not correlated with post-operative complications.

Conclusion: MIS-TLIF is a safe and reliable procedure with a low complication rate in the in and out-patient setting. With proper pt selection, MIS-TLIF is a safe and feasibility procedure in the outpatient setting.

Notes:

Effect of DEXA Scan and Patient Education on Osteoporosis Treatment Compliance

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Charles J. Gatt Jr., MD
Patricia Seuffert, MS
Dorene A. O'Hara, MD, MSE

Introduction: The Physician Quality Reporting Initiative (PQRI) is mandated by federal legislation to ensure evidence-based care. In an attempt to prevent secondary fractures, PQRI measures include reporting on communication,
management and patient counseling following fracture. The purpose of this study was to determine whether a focused patient education program by an osteoporosis nurse practitioner within a private orthopaedic practice would impact the initiation of pharmacotherapy in osteoporotic patients identified by PQRI measures.

**Methods:** Data on all Medicare eligible patients with DXA scans performed in 2011 and 2012 were analyzed in this retrospective cohort study. Starting in April 2012, all patients diagnosed with osteoporosis by DXA screening were seen by an osteoporosis nurse practitioner for standardized patient education at the time of diagnosis. Education included printed materials as well as verbal reinforcement regarding the importance of exercise as well as calcium and Vitamin D supplementation. Newly diagnosed patients with osteoporosis were referred to a dedicated endocrinologist available to the orthopaedic practice. Follow up phone calls were made to all osteoporotic patients to determine compliance with medical treatment. Outcomes were compared between groups using Chi-Square with Yates correction for small samples or Fisher’s exact test.

**Results:** Significantly more females were taking supplements in 2012 vs. 2011 after patient education was instituted. Among males, supplement use over the same time period trended positively but did not reach statistical significance. Despite thorough patient education and referral to an endocrinologist, bisphosphonate or teriparatide use by patients did not significantly increase. Compliance with bisphosphonate therapy was not affected by fracture history.

**Discussion and Conclusion:** Our study shows that the PQRI office initiative and a patient education program can successfully improve identification of osteoporotic patients. However, treatment compliance is suboptimal and further studies are required to investigate barriers to osteoporosis treatment following diagnosis and/or fracture.

**Notes:**

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**Midterm Self-Reported Quality of Life Outcomes After Spine Surgery for Lumbar Radiculopathy**

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Alex Richter, MD, MS  
Sara Merwin, MPH  
Matthew Wolfson, BS  
Jeff Silber, MD

**Introduction:** Lumbar radiculopathy (LR) is a source of significant morbidity and economic burden, with U.S. prevalence estimated between at between 3-5%, resulting in over 80,000 surgeries per year.

**Methods:** IRB approval was obtained for a follow-up survey with a validated instrument (Oswestry Disability Index — ODI) and 9 questions devised by the surgeon. Questionnaires were mailed to patients meeting inclusion criteria. Variables include: surgery type (discectomy, microdiscectomy and laminectomy), pre-surgical symptoms (back pain, leg pain, muscle weakness, numbness, claudication), pain medications, subsequent surgeries and demographics (age at surgery, sex, years since surgery).

**Results:** Of 264 subjects meeting inclusion, addresses were located for 214 (81.1%). 60 (28%) completed surveys were returned within 6 weeks, with 2 (0.9%) electing to withdraw. The patient population was 59% male with a mean age of 41.1 years (SD=12.0). The mean follow up time was 6.5 years (SD=2.1). Pre-operatively 56 (91.8%) and 52 (85.2%) of patients rated back and leg pain as 7 out of 10 or greater, respectively. Postoperatively this improved to 6 (9.8%) and 3 (4.9 %) respectively. 3 (4.9%) of patients required additional surgery and 11 (18.0%) continued to use analgesic medication, of those, 5 (45.4%) used NSAIDs with 3 (27.2%) using narcotic medications. The ODI score averaged 13%, corresponding to mild disability.

**Discussion and Conclusion:** The majority of this operative cohort reported a substantial decrease in pain after surgery and stated that disability was in the mild range. Less than 5% of patients required further surgery. These preliminary findings suggest that operative treatment for LR by this surgeon resulted in favorable outcomes. Positive response from initial mailing may over-represent patients with the best outcomes whereas patients lost to follow up may mask a proportion with poor outcomes.

**Notes:**
The Effect of Non-Steroidal Anti-Inflammatory Drug (Indomethacin) and External Beam Radiation on the Development of Heterotopic Ossification Following Extremity Blast Amputation in a Rat Model

Astor D. Robertson, MBBS
Stephen Zhao, BS
Joseph Stains, PhD
Juong G. Rhee, PhD
William L. Fourney, PhD
Vincent D. Pellegrini Jr., MD

Introduction: Heterotopic ossification (HO) in the residual limb has been a common morbidity in soldiers who survived extremity amputation via blast mechanisms during recent war conflicts. Definitive preventative treatment of the resulting complications of HO is lacking. This study was aimed at investigating the effectiveness of indomethacin and irradiation, in the prevention of HO formation following blast amputation in a rat model.

Methods: Twenty-four Sprague-Dawley rats were subjected to blast amputation of a hind limb via a column of propelled water following detonation of a submerged explosive. The amputated stump was treated with bulb syringe irrigation, minimal debridement of skin edges, and primary closure of fascia and skin. Twelve animals received an oral suspension of indomethacin at a dose of 3mg/kg for 10 days starting on operative day, while another 12 received a single dose 8Gy of irradiation to the amputated stump on the third post-operative day. A control group of twelve Sprague-Dawley rats underwent similar blasting procedure with no treatment intervention in our pilot study. Serial radiographs were done until euthanasia at 24 weeks, at which time HO severity was quantified, and HO type qualified using a grading scale previously developed in this model.

Results: One animal in the irradiation group died two weeks post-op and was not replaced. Two animals (16%) in the indomethacin group versus five (of 11, 45%) in the irradiation group developed HO contiguous to the residual stump, and no ectopic bony islands. All twelve animals in the control group had radiographic evidence of HO, either contiguous to the stump or as a bony island.

Discussion and Conclusion: While indomethacin or irradiation used prophylactically post extremism blast amputation both decreased the incidence of HO development, the effect of indomethacin was more profound. The effect of both treatment modalities combined warrants further study.

Notes:

Treating Elderly Patients with Surgical Spinal Decompression and Fusion with Multiple Comorbidities

David Eidelson, BA, JD
*Stewart G. Eidelson, MD
Sarah Eidelson, BS

Introduction: Degenerative lumbar spinal stenosis due to narrowing of spinal canal is the most frequent cause of back and leg pain in the elderly population. He purpose of this study was to assess the improvement in postoperative pain using the analogue pain scale. In particular, his study seeks to correlate the relationship between improvement in analogue pain as a function of comorbidities such as cardiac disease, hypertension, diabetes, pulmonary and GI disease.

Methods: A chart review as conducted of thirty patients 67 to 87 years of age who underwent spinal decompression with fusion. This study focused on the frequency of comorbidities such as hypertension, cardiac, diabetes, pulmonary and GI disease. Blood loss, length of stay, decline of neurological function and wound infection were also reviewed in the current study.

Results: All patients 65 to 88 years of age had at least 2 comorbidities including hypertension, cardiac disease, pulmonary and GI disease. There was no findings of postoperative wound infection or cardiac events in this subset of patients.

Discussion and Conclusion: Results of this pilot study suggests the importance of correlating multiple comorbidities with pain reduction when considering complex spinal sur-
gery in the elderly population. Comorbidities such as cardiac or hypertension are less likely to have as much improvement in pain relief. In the continuum of care involving spinal decompression and fusion procedures, patients with cardiac and hypertension should be counseled that their outcomes for pain control may be less optimal. Infection and decline in neurologic function was not evident in this postoperative group of elderly patients.

Notes:

That Resident Sutured in the Drain…Now What? — A Biomechanical Evaluation of Sutured and Retained Surgical Drains

Michael Rivlin, MD
*Olga Zielinska, BA
Irene Jimenez, BS
Paul M. Lichstein, MD, MS
Daniel W. MacDonald, MS
Steven M. Kurtz, MD
Javad Parvizi, MD, FRCS

Background: Inadvertently captured drains during wound closure may pose serious clinical dilemmas. Bedside extraction may lead to retained drain necessitating exploration; whereas, no bedside attempt may lead to unnecessary surgery. We investigated the biomechanical behavior of sutured drains.

Methods: Properties tested were: 1) Material (Silicone, plastic) 2) Shape (round, flat), 3) Perforation design (fluted, holed) 4) Needle design (cutting, taper) 5) Suture (size, braided, smooth), 6) perforation (depth, location). 372 drain/suture combinations were tested using a mechanical testing frame. Failure categories were: cut out (suture cuts through the drain), suture failure (suture breakage), and drain failure (drain split into two). Cut out and suture failures translate to a successfully extracted drain; whereas, drain failure occurred when a piece of the drain broke off.

Results: Monofilament sutures had higher occurrence of drain failure (p=0.004) and higher ultimate load (p = 0.01) than braided sutures. Needle type had no effect. Deep suture penetration withstood higher loads and lead to increased rupture rate (p< 0.002). Drain material influenced drain failure. The round perforated silicone drain group had the highest frequency of drain failure followed by flat, then fluted silicone drains. Plastic (PVC) drains did not fail but associated suture failure occurred in many instances.

Conclusion: Knowing drain type and sutures used may help direct clinicians in attempting bedside extraction of drains. The risk of drain rupture may be minimized by using drains made of silicone, using longitudinally fluted drains, making sure that minimal proximal tubing (non-perforated region) is within the wound, and braided suture is used near a drain. Caution is advised during attempted bedside drain extraction of sutured drains as even in ideal situations drain rupture may occur.

Notes:

Split-Thickness Skin Grafts for Residual Limb Coverage and Preservation of Amputation Length

Elizabeth Polfer, MD
*Gregory Van Blarcum, MD
Scott M. Tintle, MD
Jonathan A. Forsberg, MD
Benjamin K. Potter, MD

Introduction: Due to concerns regarding durability and complication rates, split thickness skin grafts (STSG) have historically been utilized sparingly for amputation coverage when primary closure is not feasible without substantial loss of length. We hypothesized that amputations with STSG would result in an increased rate of wound complications, reoperations, and heterotopic ossification requiring excision as compared to residual limbs that were closed primarily with either conventional or atypical fasciocutaneous flaps. We further hypothesized that although the complication rate may be higher, the STSG would ultimately facilitate length and level preservation as anticipated.

Methods: We performed a retrospective review of 300 consecutive lower and 100 consecutive upper extremity amputations treated at our facility from 2005- and 2003 – 2009 respectively comparing patients treated with STSG to those treated with delayed primary closure (DPC). Principle out-
comes measured included early (wound failure) and late (HO requiring excision and soft tissue revisions) complications requiring operative treatment.

**Results:** Statically significant differences were seen with the STSG group having an increased incidence of wound failure, HO requiring excision, and soft tissue revisions as compared to controls. The risks of revision were higher for lower than upper extremity amputations undergoing STSG. However, amputation level salvage was successful for all residual limbs with STSG.

**Discussion and Conclusion:** STSG for closure of amputations results in significantly increased reoperation rates, but is ultimately successful in salvaging residual limb length and amputation levels. STSG in carefully selected patients may be a successful means of achieving definitive coverage when performed over robust, healthy muscle. In many patients, however, STSG should be viewed as a staging procedure in order to maintain length and amputation level until swelling decreases and revision surgery for STSG excision with or without concurrent procedures can be performed without the need to substantially shorten the residual limb.

**Notes:**

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### Distal Tibia Fractures: Locking or Non-Locking Plate?

Nader Toossi, MD  
Douglas L. Cerynik  
Loni P. Tabb  
Amrit Khalsa  
Nirav H. Amin

**Introduction:** Distal tibia fractures are among the most common, yet most difficult fractures to treat. Plating is considered to be the treatment of choice in these fractures. Controversies abound regarding the type of plating for optimal fixation. We conducted a systematic review to evaluate and compare the outcomes of locking versus non-locking plates in distal tibia fracture treatments.

**Methods:** A systematic review was conducted using the PubMed database to identify articles reporting on the outcomes of plating in distal tibia fractures up to June 2012. We included English language articles on adult patients with a minimum of ten cases reporting acute fractures treated by single-plate, minimally invasive techniques. The demographic and outcome data of all studies was retrieved and pooled. Study-level binomial regression on the pooled data was conducted to determine the effect of locking status on different outcomes, adjusted for age, gender and other independent variables.

**Results:** 28 studies met the inclusion criteria for a total of 764 cases (499 locking, 265 non-locking). Delayed union was reported in 6% of cases using locked plating and 4.2% of cases with non-locked plating. Non-union was reported in 2.2% and 3.4% of locking and non-locking plates, respectively. An odds ratio of 0.13 for reoperation after locked plating versus non-locked plating was statistically significant. A statistically significant odds ratio of 0.10 was found for malalignment when using locking versus non-locking plating.

**Discussion and Conclusion:** This study is unique in systematically reviewing the outcomes of locked versus non-locked plating in distal tibia fracture treatment. This study demonstrated that locked plating significantly reduces the rate of reoperation and malalignment after acute distal tibia fracture treatment. Future studies are needed to translate these differences into meaningful financial figures in this era of budget-focused health care systems.

**Notes:**

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### The Effects of End Stage Renal Disease on Hospital Course and Readmission Rates in Hip Fracture Patients

Matthew Reuter, MD  
Christian Athanassious, MD  
Jason Cohen, MD  
Steve Paragioudakis, MD  
Marc S. Menkowitz, MD  
Anthony Avery, MD  
Dante Marconi, MS3

**Introduction:** End-stage renal disease (ESRD) patients face a significantly increased risk of hip fractures, a longer
recovery from them, and a shorter life expectancy after hip fracture than their counterparts with functioning kidneys. This retrospective review of 36 hip fracture patients with ESRD compares them to a control group of 36 patients from the general hip fracture population at our hospital to assess whether differences of in-hospital management are responsible for the inferior outcomes of ESRD patients in hip fracture recovery.

Methods: Thirty-six hip fracture patients with ESRD who underwent surgical fixation between 2004 and 2011 were identified by cross-referencing ICD-9 codes for hip fracture and stage III or greater chronic kidney disease. Another 36 patients with hip fractures who underwent surgical fixation were randomly selected from a list of all 488 patients with surgically fixed hip fractures admitted to our hospital between 2007 and 2011. Charts were then reviewed and compared on five parameters: length of hospital stay, time to surgery, average change in hemoglobin, 90-day readmission rates, and 180-day readmission rates.

Results: Hip fracture patients with ESRD performed worse on three of the five parameters measured. They stayed in the hospital an average of 10.20 days compared to 6.06 days for the controls. Surgery occurred an average of 3.32 days after admission for study patients compared to 1.72 days for those with normal renal function. More than half (51.40%) of the ESRD patients were readmitted within 90 days of discharge, compared to 27.78% of controls. The difference in 180-day readmissions was not statistically significant (54.10% ESRD vs. 38.89% controls) and the controls had a larger average decrease in hemoglobin (3.15 mg/dL) than the study patients (2.20 mg/dL).

Discussion and Conclusion: ESRD patients are at increased risk of short-term complications from hip fracture and should undergo surgical fixation of their fractures as soon as possible. Delaying surgery increases the risk of complications such as deep venous thrombosis and decubitus ulcers. Pre-operative medical management should focus on optimizing the ESRD patient’s medical condition for surgery as quickly as possible.

Notes: Diabetic Control in Total Joint Arthroplasty Outcomes

Saturday, November 2, 2013
Concurrent Session 15 — Total Joint Arthroplasty (Americana Ballroom Salon 4)
Moderators: Joshua J. Jacobs, MD
Henry A. Backe Jr., MD

12:00pm–12:06pm

Carlos J. Lavernia, MD, FAAOS
Jesus M. Villa, MD
David A. Iacobelli, MD

Introduction: Low and high HbA1c values have been associated with increased mortality and cardiovascular complications in diabetic patients. Our objective was to study the effects of diabetic control in the outcomes after total joint arthroplasty (TJA).

Methods: 121 consecutive primary TJA’s were performed in type 2 diabetic patients. Patients were stratified into quartiles based on their preoperative HbA1c levels. Patient oriented outcomes (QWB-7, SF-36, and WOMAC), complications, length of stay (LOS), and hospital costs were compared between quartile groups. ANOVA and independent t-test were used to compare outcomes. A p-value of less than 0.05 was considered significant.

Results: At 2.7 years (range: 2-5 years) there were no significant differences between quartiles. A trend for worse scores in the lowest 25% and highest 25% quartiles was identified for the QWB-7 (LQ25%: 0.627; IQ50%: 0.637; HQ25%: 0.627); SF-36 role physical (LQ25%: 71; IQ50%: 78; HQ25%: 77); SF-36 social functioning (LQ25%: 72; IQ50%: 78; HQ25%: 76), and SF-36 mental health component (LQ25%: 55; IQ50%: 57; HQ25%: 55); WOMAC function (LQ25%: 7; IQ50%: 3; HQ25%: 5) and WOMAC total (LQ25%: 8; IQ50%: 4; HQ25%: 7). Hospital length of stay and costs were higher in both the lowest 25% and the highest 25% quartiles. After controlling for all confounders, this inverted U-shaped pattern was still observed and was statistically valid. There were no significant differences in complications between quartiles. All perceived outcomes improved significantly two years after surgery.

Discussion and Conclusion: We found that type 2 diabetic patients with hypoglycemia and hyperglycemia, as mea-
Concurrent Session 15 Abstracts

**Vitamin D Deficiency in Total Knee Replacement Surgery**

Jesus M. Villa, MD  
David A. Iacobelli, MD

**Introduction:** Adverse outcomes have been reported in patients with subnormal Vitamin-D (vit-D) levels. Our main objective was to investigate the relationship between preoperative vit-D levels and outcomes in patients with end-stage OA who underwent primary TKR, and to determine the effects of vit-D supplementation on outcomes in patients with low-levels.

**Methods:** 180 consecutive patients (196 knees) were studied. Patients were divided into two groups (normal or low) based on preoperative plasma 25-hydroxyvitamin-D3 levels. Demographics and preoperative BMI, ASA, Charlson, albumin, transferrin, calcium, total lymphocyte count (TLC); preoperative and postoperative QWB-7, SF-36, WOMAC, Knee Society (KS) and HSS knee scores were compared between groups. Based on internist preferences, some of the deficient patients received vit-D supplementation. We further stratified deficient patients into those who received supplementation and those who did not. Alpha was set at 0.05.

**Results:** Overall prevalence of low vit-D levels was 66% using the standard threshold (30 ng/mL). Patients with deficiency had higher mean BMI (31.8±S.E.0.83) compared to normal-level patients (29.9±0.42). 26% of females had deficiency before surgery in contrast to 12% of males. Compared to normal patients, those with low-levels had significantly worse mean pre-operative WOMAC function (40.1±0.78 vs. 44.4±1.34), WOMAC total (53.8±1.05 vs. 59.7±1.80), SF-36 function (11.6±1.18 vs. 4.8±1.34), and SF-36 physical-component scores (22.7±0.42 vs. 20.4±0.56). Postoperatively, normal-level patients had better SF-36 mental-health scores than patients with deficiency (74.1±0.97 vs. 69.6±2.46). The remaining laboratory values were not different between groups. There were no significant improvements in outcomes in vit-D deficient patients who received supplementation while in the hospital.

**Discussion and Conclusion:** Vitamin D deficiency is fairly prevalent in patients who undergo TKR even in sunny cities like Miami. Obese patients and females were deficient when compared to males and patients with normal BMI. Patients with low-levels had poor preoperative WOMAC, SF-36, and worse postoperative SF-36. Preintervention supplementation is safe, inexpensive, and could positively affect outcomes in patients who undergo primary TKR.

**Notes:**

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**Effects of Steroids on Thrombogenic Markers in Patients Undergoing Unilateral Total Knee Arthroplasty**

Alexander S. McLawhorn, MD, MBA  
Kethy Jules-Elysée, MD  
Thomas P. Sculco, MD  
Jonathan Beathe, MD  
Jacques YaDeau, MD, PhD  
P. Edward Purdue, PhD  
Yan Ma, PhD

**Introduction:** Despite thromboprophylaxis therapy, venous thromboembolism (VTE) remains an important complication for patients receiving total knee arthroplasty (TKA). Systemic thrombin generation starts in the perioperative period, with a demonstrable rise in thrombogenic markers 4 hours post-surgery. Inflammation, characterized by a rise in interleukin-6 (IL6), initiates the coagulation cascade via expression of tissue factor. Low-dose steroids have been shown reduce post-TKA IL6 levels and to stimulate tissue plasminogen activation, leading to fibrinolysis. In this study, we assessed the effect of perioperative steroids on the release of plasmin anti-plasmin (PAP), a marker of fibrinolysis, and prothrombin fragment (PF1.2), a marker of thrombin generation.

**Notes:**

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Methods: This triple blinded placebo-controlled study was IRB approved. 24 patients undergoing unilateral TKA were included (13 placebo, 11 study). The study group received 100 mg of intravenous hydrocortisone 2 hours prior to surgery. The control group received normal saline. Blood samples were drawn pre-incision and at 4 hours post tourniquet (TQ) release, then centrifuged at 3500 rpm. Supernatants were assayed for PAP and PF1.2.

Results: The mean rise in PF1.2 in the control group was significantly greater compared to the study group (674+/-260 pMol/L vs. 349+/-332 pMol/L). The study group had significantly lower mean PF1.2 at 4 hours compared to controls (615 +/- 357 pMol/L vs. 937 +/- 317 pMol/L). Mean PAP was higher in the study group at 4 hours (1638 +/- 823 mcg/L vs. 1206 +/- 624 mcg/L), but did not reach statistical significance. Baseline means for PF1.2 and PAP were not different between groups.

Conclusion: Pre-operative steroids significantly decrease thrombin generation 4 hours post TKA, without interfering with fibrinolysis. The mechanism is likely due to reduced IL6-mediated activation of the coagulation cascade. These results may have significant clinical implications in terms of post-operative VTE risk and management. Clinical studies are needed for further evaluation.

*The FDA has not cleared this drug and/or medical device for the use described in the presentation. (Refer to page 54).

Notes:

Implant Failure Associated with an M2 Macrophage Immunopathology

Jeffrey A. Moore, BS
Pankaj K. Mishra, PhD
Bonnie A. Buechel, MS
Mark J. Palma, MS
Kathleen S. Beebe, MD
Joseph Benevenia, MD
William C. Gause, PhD

Introduction: Total joint arthroplasty is commonly used in Orthopedics to treat symptoms of pathological joint diseases including osteoarthritis, rheumatoid arthritis, and osteonecrosis. However, implants can loosen and ultimately fail over time, causing pain and ambulatory issues for the patient. This loosening may result from inflammation caused by the release of implant micro particles or “wear debris” into the surrounding tissue. Our previous studies in mice suggest that the micrometer sized titanium particles trigger an innate type 2 response, characterized by alternatively activated (M2) macrophages, neutrophils, and eosinophils. Based on these findings, we hypothesized that wear debris microparticles shed by implants in human subjects that accumulate in the periprosthetic tissue may lead to type 2 inflammation and recruitment of M2 macrophages, ultimately contributing to osteolysis and aseptic loosening.

Methods: After institutional review board approval, 32 patients (27 primary and 5 revision) undergoing total joint arthroplasty were enrolled in the study. We intraoperatively collected either synovial like tissues from primary joint arthroplasties (controls) or periprosthetic tissues from revision arthroplasties. Half of each specimen was embedded in OCT and half was used for RNA isolation. Gene expression of immune cell markers was determined using real-time PCR. Staining was performed on OCT sections using a fluorescent labeled CD68 antibody.

Results: Initial staining with CD68 indicates increased infiltration of macrophages in revision patients. Gene expression analysis of revision patients showed significantly increased expression of Insulin-like Growth Factor-1 (IGF-1), Chitinase-1 (CHIT-1), CCL-18, and Fibronectin (FN2) (77-fold), but no increases in IL-12.

Discussion and Conclusion: Our data suggests that implant wear debris causes inflammation characterized by an infiltration of M2 macrophages, and is associated with aseptic loosening requiring revision surgery. This study may help identify important targets for future therapeutic control of implant failure and may aid in the potential development of prosthetics that limit tissue inflammation.

Notes:
Length of Stay and Day of Surgery in Total Knee Arthroplasty

Antonia F. Chen, MD, MBA
Susannah G. Cafardi, BA, MPH
Peter Cohen, MD
Brian Klatt, MD

**Introduction:** Previous studies have demonstrated that decreasing hospital length of stay (LOS) increases quality of life and reduces costs. Therefore, it is desirable to implement programs that prepare total knee arthroplasty (TKA) patients for earlier discharges. The purpose of our study was to determine there was a difference in hospital LOS and complications based on the day of surgery for TKA.

**Methods:** TKA Medicare patients were retrospectively studied from 2009 using a 20% nationally representative sample of Medicare claims data. Procedures were identified using CPT-4 codes in Medicare claims. Patient data was collected using encrypted beneficiary identification identifying day of surgery, LOS, age, race, gender, comorbidities, socioeconomic class (dual status), and complications (emergency department revisits within 30-days, 30-day readmissions, infection, death, and DVT/PE) were collected. Standard descriptive statistics were performed and a Poisson regression model was used to compare LOS between the days of the week, controlling for comorbidities and demographic predictors.

**Results:** There were 47,337 TKA patients; 14,846 patients on Monday, 14,177 TKAs on Tuesday, 8,587 TKAs on Wednesday, 5,939 TKAs on Thursday, and 3,788 TKAs on Friday. The average LOS was 3.50 days. There was a decrease in LOS of 0.23 days (95% CI 0.16-0.30, p<0.001) for TKAs done on Mondays compared to Fridays and a decrease of 0.35 days (95% CI 0.29-0.41, p<0.001) for TKAs done on Mondays compared to Thursdays. Findings were similar for TKAs performed on Tuesday, compared to Thursday and Friday.

**Discussion and Conclusion:** Our study demonstrates that undergoing a TKA on Monday or Tuesday results in a shorter hospital LOS compared to undergoing a TKA on Thursday or Friday with no difference in complications. Thus, it is desirable to perform TKAs earlier in the week compared to later in the week.

**Notes:**

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Intraarticular Pain Pump Reduces Opioid Consumption After TKA

Hind Sawan, BS
Benjamin Hendy, BS
Amanda C. Gulasarian, BA
Camilo Restrepo, MD
Mitchell Maltenfort, PhD
Javad Parvizi, MD, FRCS

**Introduction:** Adequate pain management following total knee arthroplasty (TKA) is the most important factor in patient satisfaction. However, management of postoperative pain and complications from pain management techniques remains one of the greatest unmet challenges. The purpose of our study is to evaluate patients receiving the intraarticular pain pump in terms of pain perception, opioid consumption, in hospital complications and length of stay as compared to patients receiving patient-controlled analgesia (PCA).

**Methods/Materials:** Using a prospectively collected database, we identified 270 consecutive patients undergoing TKA between December 2011 and April 2012 who received intraarticular pain pumps delivering ropivican following surgery. Using the same database, we identified 234 consecutive patients undergoing TKA between December 2007 and March 2008, who received PCA and did not receive an intraarticular pain pump. Data regarding postoperative pain management was collected and analyzed through visual analog score (VAS), opioid consumption, postoperative complications, and length of stay.

**Results:** Patients in the intra-articular pain pump group had a lower VAS scores than patients in the PCA group on postoperative day (POD) 1 and POD 2. The PCA group experienced more hematological and gastrointestinal postoperative complications than the pain pump group. Patients receiving pain pump reported a reduction in opioid consumption up to POD 3 and a decreased length of stay.

**Discussion:** In patients undergoing TKA, pain was effectively controlled in both the pain pump and PCA group. However, patients receiving the pain pump had adequate pain management without the adverse effects and complications associated with opioid consumption.

**Notes:**
The Reduction of Implant-Related Errors and Waste in Total Knee Arthroplasty Using a Novel, Computer Based, e.Label and Compatibility System

Michael P. Ast, MD
David J. Mayman, MD
Edwin P. Su, MD
Alejandro Gonzalez Della Valle, MD
Michael L. Parks, MD
Mathias P. Bostrom, MD
Steven B. Haas, MD, MPH

Introduction: Wasted implants represent both an increased risk and cost to our healthcare system. In our institution, a sterilely packaged implant that is opened and not implanted is wasted in one out of 20 primary total knee replacement procedures. The cost of these wasted implants exceeds $1 million per year. We propose the introduction of a novel, computer based, e.Label and compatibility system to reduce implant-related medical errors and waste in total knee arthroplasty. We hypothesize that the implementation of this system will help reduce medical errors and wasted implants by improving and standardizing the visual markers and by ensuring that parts are compatible so that implant mismatches and inappropriate laterality are prevented.

Methods: A software program was implemented which creates an e.Label for all components and checks imbedded, manufacturer provided, compatibility charts to ensure that parts are of appropriate laterality, and are compatible with each other. Upon implementation, the program was studied prospectively for seven months and compared to a retrospective cohort in regards to number, type, and cost of wasted implants. Critical errors that were detected were also recorded.

Results: During the retrospective period there were 83 wasted implants in 1450 surgeries, or an incidence of 5.7%. After implementation of the computer based system, there were two wasted implant in 244 surgeries performed by the study physicians, or an incidence of 0.8%. One critical medical error was identified and prevented during the study period. The annualized cost savings from this decrease in wasted implants was over $200,000 among our six study surgeons.

Conclusion: The introduction of this system was able to prevent at least one serious medical error, while dramatically decreasing the number and cost of wasted implants in our institution. Implementation on a larger scale may provide potential for safer, more efficient, and more cost-effective orthopaedic care.

Notes:

Total Joint Arthroplasty in Patients with Inflammatory Bowel Disease

Jeffrey Oliver, BS
Camilo Restrepo, MD
Javad Parvizi, MD, FRCS

Introduction: Total Joint Arthroplasty (TJA) procedures have become a mainstay in orthopaedics, alleviating suffering and providing functionality in many arthritic patients. Identification and optimization of at-risk groups is essential for the success of TJA, serving to prevent severe complications such as infection. One potential at-risk group includes Inflammatory Bowel Disease (IBD) patients, susceptible to osteoarthritis as an extra-intestinal manifestation of their disease and complications due to immunosuppressant therapy.

Methods: We queried our institution’s retrospective database for patients undergoing total hip and knee replacements or revisions with concomitant IBD or related irritable bowel and colon diseases. We identified 408 patients (449 procedures) that had been performed on patients with IBD from January 2000 to June 2012. From the database and electronic medical records, detailed data including demographic information and outcomes pertaining to complications, diagnoses, readmission and mortality were collected. There were ten cases of periprosthetic joint infection in the cohort. Mechanical loosening accounted for 15 revisions, with other mechanical malformations, fractures, and dislocation accounting for the rest.

Results: The average age was 62.78 years (range twenty-seven to ninety-one), with 200 knee replacements, 192 hip placements, 24 knee revisions, and 33 hip revisions. A total of 77 complications in 44 patients were detected. Blood-related complications accounted for the majority of these complications (35%), with general (29%), Pulmonary and Gastrointestinal (both 12%), Renal/Urinary (10%), and Cardiac (2.6%) complications to follow.
Discussion and Conclusion: PJI as a cause of revision was not elevated within the cohort, something which can likely be attributed to optimization strategies at our institution, which include halting immunosuppressant therapy four weeks pre and eight weeks post-surgery.

Notes:

Saturday, November 2, 2013
Concurrent Session 16 — Sports Medicine and Oncology (Poinciana 1 & 2)
Moderators: Mark J. Lemos, MD
John A. Abraham, MD

12:00pm–12:06pm
Resident Travel Grant Award Winner
Evaluation of Hip Internal and External Rotation Range of Motion as an Injury Risk Factor for Hip, Abdominal and Groin Injuries in Professional Baseball

Richard Ma, MD
Xinning Li, MD
Matthew Thompson, MD
Courtney Dawson, MD
John J. Steele, BS
Joseph T. Nguyen, MPH
Struan H. Coleman, MD, D.Phil
Hanbing Zhou, MD

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 orthopaedic 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.

Discussion and 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.

Notes:

12:06pm–12:12pm
Use of an Emergency Room External Fixator for Initial Stabilization of Pilon Fractures

Philip McClure, MD
Dale Cassidy, MD
Stephen A. Klinge, MD
Christopher W. DiGiovanni, MD
Roman A. Hayda, MD

Introduction: There is a paucity of data available on placement of an external fixator in the emergency room (ED ex-fix) for provisional stabilization of pilon fractures. It is
unclear if neurovascular injury or infection rates differ versus standard treatment.

**Methods:** Over a seven year period, 26 patients who had a uniplanar ED ex-fix placed for type 43B or 43C tibia pilon fractures were compared with 16 patients who had delta frame external fixators placed in the operating room (OR ex-fix). Radiographic data was reviewed to evaluate fracture classification, pin placement and reduction. Clinical notes were reviewed to confirm 6-month follow-up, the presence of wound complication, deep infection, nerve injury, and non-union. Co-morbidities (e.g. diabetes and history of tobacco use) were also recorded.

**Results:** 3/26 (12%) patients in the ED ex-fix group developed deep infection, compared to 2/16 (13%) in the OR ex-fix group. 7/26 (27%) patients in the ED ex-fix group had wound complications compared to 5/16 (31%) in the OR ex-fix group. Each group had 4 nerve injuries, which continued to improve throughout follow up. 42% of ED ex-fixes returned to the OR prior to definitive treatment compared to 19% of OR ex-fixes. On average, 1.6 operations were needed to treat patients in ED ex-fix group in the study period, compared to 2.3 operations for the OR ex-fix group; and includes late removal of hardware and other secondary procedures.

**Discussion and Conclusion:** Use of the ED ex-fix appears to be a safe and effective alternative to external fixation applied within the operating room. Advantages include decreased trips to the operating room and associated cost, rapid availability, and earlier soft tissue stabilization as well as advanced imaging. It appears that this method did not increase the risk of deep infection or neurovascular injury in our cohort.

**Notes:**

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**Cost Benefit Analysis of Athletic Team Coverage by an Orthopaedic Practice**

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**Introduction:** Coverage of high school athletics by orthopaedic surgeons is considered standard of care in many localities. Time away from an orthopaedic practice to provide on field athletic care has potential advantages and disadvantages. The purpose of this investigation was to perform a cost/benefit analysis of local sports coverage by an orthopaedic sports medicine practice.

**Methods:** From January 2010 to June 2012, a prospective injury report database was used to collect sports injuries from five high school athletic programs covered by a single orthopaedic practice. Patients referred for orthopaedic care were tracked to determine ultimate cost of care. E&M and CPT codes were obtained to determine the value of physician visits and surgical care, using standardized Medicare reimbursement rates. Direct costs were estimated based on time required for team coverage and hourly reimbursement rates for orthopaedic surgeons, based on previously reported data.

**Results:** 19,165 athletic trainer evaluations resulted in 473 (2.5%) physician referrals. The covering practice handled 89 (27.9%) of the orthopaedic referrals. Of the orthopaedic referrals, 26 (5.4%) required orthopaedic surgical treatment. The covering practice handled 17/26 (65%) surgical cases. The total cost of orthopaedic care for athletes requiring treatment was $44,239.94. The total revenue collected by the covering practice was $26,226.14. Cost of an orthopaedic physician for the required hours of coverage was $12,627.81. Overall profit of visits and treatment for the covering practice was $13,598.33 (43% of possible profit). Total possible profit during the study period was $31,612.13. Calculated hourly rate of reimbursement for a covering orthopaedic surgeon was $116.23/hour.

**Conclusion:** A potentially profitable and personally beneficial engagement with local athletes can lead to a symbiotic relationship between physicians and their local communi-
ties. The hourly rate of reimbursement based on this revenue for the covering orthopaedic surgeon is only slightly higher than found in a prior study.

Notes:

Female Athlete Triad Awareness Among Residents and Attending Across Specialties

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Kathryn E. Ackerman, MD, MPH
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Introduction: Female athlete triad is a debilitating disorder that can have lifelong consequences for the female athlete, if left undiagnosed. Prior studies assessed female athlete triad education among coaches/athletic trainers reported surprisingly low awareness results. We assessed 1) how many physicians/residents had heard of the female athlete triad and 2) how many can properly diagnose or refer patients to appropriate specialists.

Methods: We recruited MD faculty and residents at one institution across specialties to answer an 8-item test on triad awareness and knowledge. A total of 416 responses were recorded.

Results: There were 41% male and 59% female responses (33% resident and 66% attending). Average number of years in practice for attendings was 15.2 +/- 10.6 and years in residency was 2.7 +/- 1.2. Overall, 29% of residents and attendings had heard of the female athlete triad. Of these respondents, an average of 1.6 +/- .8 of the 3 components were properly identified with an overall average score on the triad awareness test of 66 +/- 16%. 53% felt comfortable treating or referring a patient with the triad, while 47% did not. More residents had heard of the triad than attendings (35% vs. 26%); however, both groups had similar overall scores (65% vs. 67%). Attendings report feeling more comfortable than residents in treating/referring patients with the triad (56% vs. 47%). When assessing awareness between specialties, the three with highest awareness were orthopaedics (78%), pediatrics (62%), and PM&R/Rheumatology (59%). The three with lowest awareness were pathology (0%), surgery (7%) and anesthesiology (8%)/radiology (8%).

Discussion and Conclusion: Our findings suggest that less than a third of the residents/attendings have heard of the female athlete triad. Those aware of the triads scored 66 +/- 16% on the overall knowledge to properly treat/refer. Increased awareness through education to properly identify and manage the female triad is needed in orthopaedics.

Notes:

Epiphyseal and Growth Plate Sparing in Children with Malignant Bone Tumors. Segmental Resection and Reconstruction Using Allograft Vascularized Fibular Graft. The Biological Solution

Samuel Kenan

Introduction: Limb length discrepancy following wide resection of distal femur or proximal tibia in young children presents a major challenge. Attempt to overcome this problem using the expandable prosthesis has been associated with high morbidity related to multiple revisions. In an attempt to save the knee joint and growth plate, in selected patients in whom the tumor is away from the growth plate, transmetaphyseal or transepiphyseal resection has been performed successfully. The outcome in twelve patients is presented.

Material and Methods: From 1990-2012, twelve patients with malignant bone tumors were treated. 10- osteosarcoma, 2-Ewing’s sarcoma. Age: 5 to 18 years. 7-male, 5- female. All received chemotherapy. 8-distal femur, 4-proximal tibia. In ten patient’s transmetaphyseal resection and in two, transepiphyseal resection was performed. In four with distal femur, combined allograft vascularized fibula was used, all other had segmental allograft.

Results: Follow-up period was from 6 months to 22 years. In four patients, follow-up was 18 to 22 years. All patients are disease free. There were no immediate complications. In two patients allograft fracture has to be treated by improved fixation. In one patient with distal femur allograft after three...
years, fracture required revision using vascularized fibular graft. In one patient, revision using prosthesis was performed. The growth plate was preserved in ten patients, all continued growth without significant limb length discrepancy. All patients regained full active range of motion of the knee and returned to normal lifestyle activity. Based on the M.S.T.S functional evaluation, excellent results were achieved in 10 patients.

Discussion: In the last decade better understanding of the biological behavior and improved radiographic imaging and at the same time effective chemotherapy treatment has enabled us to measure accurately the tumor extension. These advances made it possible to come closer to the tumor with adequate surgical margins. In patients in whom the tumor is away from the growth plate, transmetaphyseal or transepiphyseal resection could be performed successfully, saving the knee joint and growth plate allowing continues growth and minimizing limb length discrepancy. The surgical defect could be restore by an intercalary allograft combined with vascularized fibular graft. In twelve selected patients with malignant bone tumor about the knee joint such procedure was performed successfully. This Biological solution proven to be effective, all patients continued growth without significant limb length discrepancy. All patients regained full active range of motion of the knee and returned to normal lifestyle activity. Based on the M.S.T.S functional evaluation, excellent results were achieved in 10 patients.

Notes:

12:30pm–12:36pm

Does Age Affect Healing Time and Functional Outcomes After Fracture Nonunion Surgery

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Introduction: Due to the setting of medical co-morbidities, poor vascularization, osteopenia, and diminished osteogenic potential, age is a risk factor for fracture nonunion. The multiplicity of risk factors predicting fracture nonunion compound the success of nonunion revision surgery in the elderly. The purpose of this study was to investigate the effect of patient age on clinical and functional outcome following long bone nonunion surgical repair.

Methods: Two-hundred and eighty-eight patients with fracture nonunion were prospectively enrolled in a research registry. Patients were all treated irrespective of age by experienced surgeons. Length of hospital stay after surgery and medical co-morbidities were documented. Patients were tracked for a year with follow-up at regular intervals. Elderly patients >65 years of age were compared with non-elderly for wound complications, SMFA scores, healing, and surgical revision. Regression modeling analysis for associations between continuous age, smoking status, and history of previous nonunion surgery with healing was performed.

Results: Follow-up data was available on 278 patients ranging 18-91 years (mean=48.0). Forty-five patients were >65years. The elderly included significantly more females and mean number of medical co-morbidities, particularly osteopenia. Significantly fewer elderly reported smoking. Number of previous nonunion surgeries and BMI did not differ. Rates of post-operative wound complications were similar. Surgical revision, progression to union, and union time were similar. Similar levels of functioning were reported up to 12 months after surgery. Regression model analyses failed to show association between age and healing. However, it did show strong associations between smoking status and previous nonunion surgeries with healing time.

Discussion and Conclusion: Patient modifiable risk factors, such as smoking, and failure of previous surgery were more associated with nonunion revision success than age in this study. Advancing age may be less strongly associated with nonunion surgery outcome than the risk factor milieu predisposing to baseline fracture nonunion

Notes:
Intramedullary Nail Stabilization with Adjuvant Bisphosphonate and Radiation Use for Impending Pathologic Fractures: A Retrospective Review

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Introduction: Metastatic bone disease causes pain, pathological fractures, limited mobility, and metabolic irregularities that dramatically affect quality of life. The goal of prophylactic surgical fixation is to prevent fracture, reduce pain, and provide rapid recovery and weight bearing without significant interruption of treatment. In the past, it was thought that certain lesions required more extensive treatment than intramedullary (IM) nailing, such as curettage and cementation. However, with improvements in radiation and bisphosphonate therapy, this may not be the case. The purpose of this paper is to describe outcomes of IM nail stabilization with adjuvant bisphosphonate and radiation therapy without intralesional curettage and cementation for impending pathological fracture.

Methods: Retrospective review of surgical database identified patients with impending or pathologic long bone fractures. Intervention in these patients included IM nails, bisphosphonates, and radiation between August 2010 and January 2013. Outcomes include failure, defined as: completion of fracture, or reoperation for mechanical problem, removal of implant, or implant conversion.

Results: We identified 24 lesions treated with IM nail fixation coupled with bisphosphonate and radiation therapy for impending fracture. Of these lesions, 17 were femoral and 7 humeral. Lesion histologies included breast cancer, multiple myeloma, hepatocellular carcinoma, renal cell carcinoma, cholangiocarcinoma, pancreatic, lung, and colon cancer. Follow-up ranged from 11 to 653 days, with a mean of 139 days. We observed no failures.

Conclusion: We present a series of consecutive patients treated with IM nailing, bisphosphonate therapy, and post-operative radiation for impending fractures from metastatic cancer to bone. In this series, no patients experienced failure, regardless of histology, or needed a reoperation. Although a small series, this suggests that traditional approach to lesions including curettage and cementation may be unnecessary with the addition of bisphosphonate and radiation therapy. Further study will be needed to prove this hypothesis.

Notes:
One unit increase in catastrophizing score was associated with an OR of 0.96 (CI 0.87 0.99), one-year increase in age had an OR 0.95 (CI 0.87 0.99), one unit increase in rumination had an OR 0.89 (CI 0.74, 0.97), and one unit increase in helplessness had an OR 0.92 (CI 0.87, 0.99).

**Conclusion:** Increasing age, BMI, and higher catastrophizing pain scale scores show slightly lower odds of postoperative opioid usage and referral to a pain management after TKA. This can help surgeons console their patients preoperatively and set expectations during the recovery period.

**Notes:**